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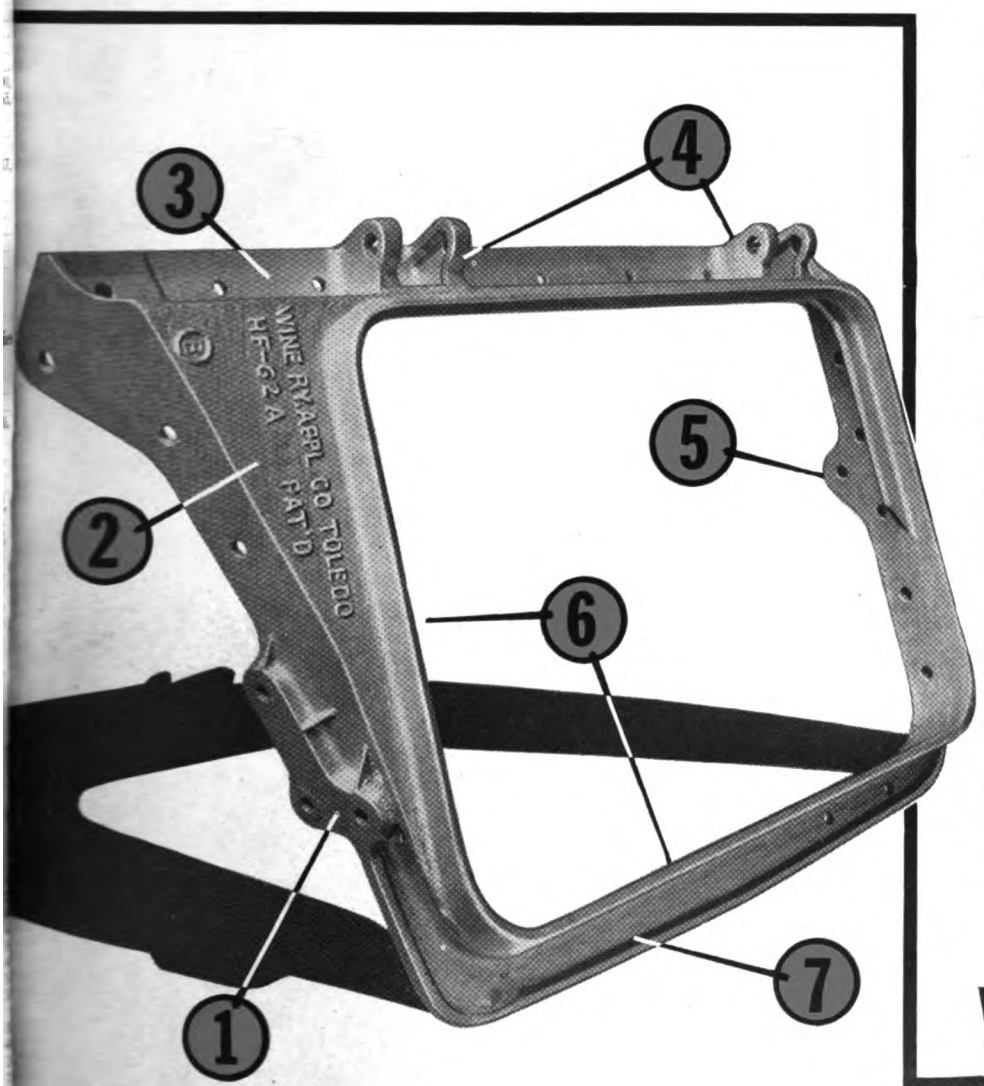

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5 CENTER SILL ATTACHMENT PREVENTS SPREADING AND SAGGING OF HOPPERS

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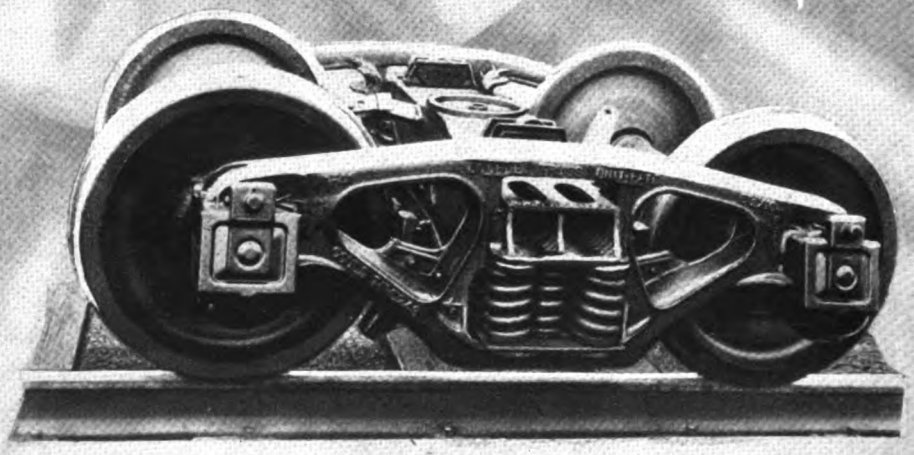

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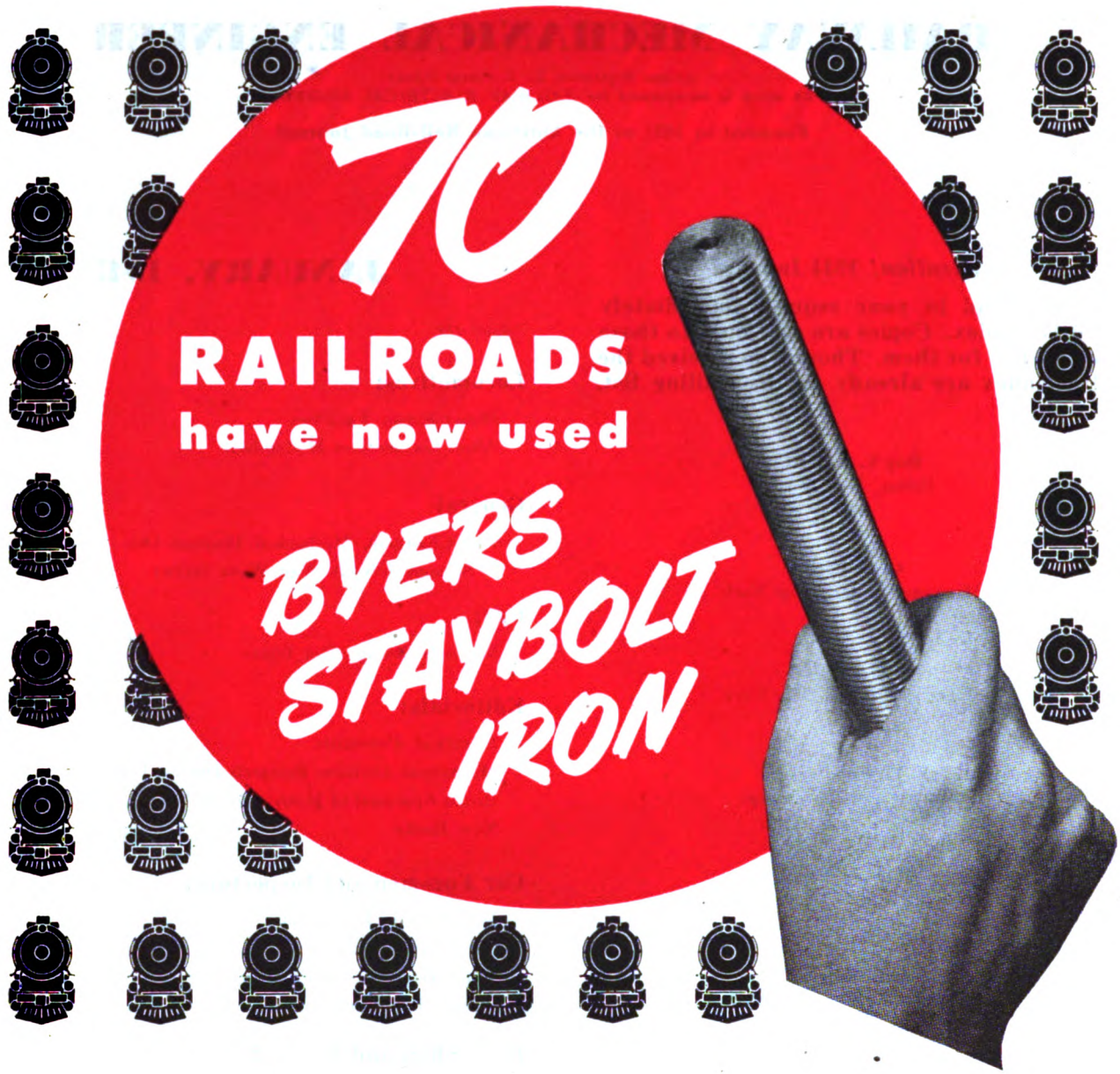

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RAILWAY
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Diesel Repair Facilities*

By P. H. Hatch†

The character of repair shops for railroads operating this type of power depends on the number and type of units and the road's maintenance policy

ORIGINALLY, Diesel-electric locomotives were purchased and applied to railroad work more or less as individual units and not as classes of motive power superseding the existing types. Hence their servicing, inspection and repairs were on a special basis and handled by special crews. Reliance in large degree was placed on the manufacturers as to methods, tools and materials to be used as well as for general supervision. The entire application had an experimental air about it so that such items as permanent organizations, adequate stores, effective facilities, etc., were given little attention beyond the requirements for day-by-day operation. Such things as long-term maintenance programs and backshop repairs or overhauls were hardly considered. In short, the new locomotives were superimposed on the existing motive power picture and left to prove their worth. They were fortunate indeed if they arrived on a railroad having had experience with gas-electric rail cars or electric locomotives, particularly the latter, since basically Diesel-electric locomotives are electric locomotives with self-contained power plants.

This state of affairs lasted only during the early stages of Diesel-electric application. As soon as any railroad acquired an appreciable number of Diesel-electric locomotives, the necessities of servicing and maintenance facilities became important for the very sufficient reason that the railroad could not afford to waste valuable service hours which could be saved by an investment in such facilities.

To cite an example, it was no longer economical to have a fleet of Diesel switchers meet highway tank wagons for fueling, though this could be tolerated when necessary where one or two locomotives were involved. Terminal fuel and associated facilities were required and were quickly installed.

Locomotive Terminals

Regarding facilities for running and backshop repairs, much the same situation prevailed. At first, existing facilities, whether suitable or not for Diesel-electric locomotives were used with the addition of the bare necessities. Then as additional units of this type were purchased, it become necessary to furnish efficient means for maintaining the locomotives as Diesel-electric locomotives and not as adjuncts of other types of equipment.

The following, therefore, outlines the more important items of facilities and methods used for maintaining Diesel-electric locomotives at locomotive terminals and at backshops. There are two classes of work to be done at locomotive terminals. One is routine servicing, the other is regular or periodic attention. Included in the first is fueling, watering, sanding, addition of lubrication oil, I. C. C. daily inspection and general check of condition of Diesel-engine or engines, electrical equipment, mechanical parts, air brakes, safety appliances, etc., all of which is necessary to release the locomotive for its next run in road service or tour of duty in switching service. Included in the second is periodic inspection and maintenance, I. C. C. monthly and annual inspections, and all repairs or replacements of parts required as the result of continued operation or failures in service.

The principal facilities required for routine servicing consist of fuel oil storage and disbursing equipment, water filling connections, sand towers, lubricating-oil storage, heating and disbursing equipment, source of steam for keeping locomotives from freezing in winter weather or for thawing purposes, a pit or pits suitably lighted for running-gear and underneath inspection and, last but not least, a shed, house or covered area where this work can be done protected from the weather. This latter provision is, of course, not an absolute requirement but it will go far toward increasing the efficiency of the forces handling locomotives for turnarounds.

Inspection and Maintenance Facilities

The principal facilities required for regular inspection and maintenance include a suitable building accessible both by rail and street or highway, tracks with deep, well-drained and well-lighted pits, traveling crane, jib cranes, drop table, locomotive hoist or high-speed power jacks for trucks and wheel changes, wheel lathe, wheel press, small machine shop including toolroom and containing such items as lathe, drill press, milling machine, grinding wheel, cylinder-head valve seat and valve grinder, etc., electrical repair room including simple electrical testing equipment as, for example, high potential test outfit, Megger tester, ohmmeter, bell box, etc., combined air-brake and piping room including facilities for air-brake apparatus testing and repair, also nozzle or injector testing outfit and means for mounting and driving Diesel-engine governors for adjustment, simple sheet-metal tools and

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* This is the first of three articles dscussing general and running repair facilities for Diesel locomotives. The second and third articles will appear in subsequent issues and will discuss, respectively, engine and mechanical equipment repairs, and electrical repairs.

electric and acetylene welding equipment. Other facilities should possibly include a few items of blacksmith equipment, lubricating-oil reclaiming apparatus, locomotive washing provisions, battery-charging equipment, including charging lines and outlets, ample provision for storing and disbursing spare parts and the usual offices, locker rooms, showers and toilet facilities for the convenience of personnel.

The foregoing is based on the complete facilities required for a large Diesel-electric locomotive terminal, assuming that there is nothing to start with and everything is installed new. In nearly all cases, railroads have available in or around existing terminals or shops more or less of the equipment listed and it is a problem of regrouping or rearranging such items of these facilities as are necessary, or else of sending the locomotives to different nearby points for the work required. While this latter is often the procedure, it is frequently not the most efficient and in many cases money and time might be saved by the installation of a terminal exclusively for Diesel-electric motive power.

Taking up various items one by one, the following general factors should be considered in planning such a terminal:

The Building

It should be well ventilated, arranged to take full advantage of daylight without the glare of direct sunlight, and should be well lighted at night with a minimum of shadow. It must be designed for the headroom required for cranes or hoists and, if at all possible, should have tracks running through it and not stub-ended so equipment does not have to be jockeyed around to accommodate incoming and outgoing moves. The necessary outlets or connections for portable lights, welders, air, etc., should be provided and the interior should be adequately and uniformly heated in winter. If Diesel engines are to be run indoors, suitable roof ventilation or smoke jacks should be installed.

As mentioned previously, track pits should be deep, well drained and well lighted; the depth should be 54 in. to 60 in. from the top of the rail. It is also desirable at least at some tracks to drop the floor level along the pits and run the rails on I beams or wood stringers from 12 in. to 15 in. above the floor to facilitate truck work, changing of brake shoes and general accessibility of the under part of the locomotives at the sides. Incidentally, it is far preferable to have a pit deeper than actually necessary at all times for it is always possible to provide boxes or staging to stand on if required to reach certain parts of the locomotives. A pit which is too shallow is a constant source of annoyance and an invitation to inefficiency.

Hoisting and Lifting Equipment

An overhead crane of moderate capacity is very convenient for lifting items of equipment on the locomotives out through the roof, as for example, cylinder heads, pistons, liners, blowers, super-chargers, compressors, electrical apparatus, etc., but by reason of additional headroom and structural supports required may increase the building cost materially. Probably the best and most economical scheme is a series of jib cranes located in various places throughout the shop. The principal restrictions involved with jib cranes is a limited area of coverage and a limited lifting capacity. This is usually in the neighborhood of three to four tons maximum. A compromise between an overhead crane and a battery of jib cranes might be a floor-controlled monorail hoist.

For the larger job of removing trucks from under locomotives several methods are available. One is overhead cranes and another is a locomotive hoist for lifting the locomotive so either or both trucks can be rolled out. This is usually an expensive installation though it is a time saver if both trucks have to be removed at the some time. In this connection some railroads have converted existing hoists formerly used for steam locomotives so they can be used for Diesel-electric locomotives by removing the cross members and installing special brackets on each side.

A variation of this same method is power-operated jacks with a suitable foundation on which they can be placed to lift the locomotive. This is probably the least expensive method but it is subject to the inherent limitations of jacking and supporting when heavy weights and fairly appreciable heights are involved.

Probably the best all-around arrangement if an entirely new installation is to be made is a drop table large enough to accommodate a complete truck and arranged to serve two or more tracks. This results in maximum flexibility, is comparatively reasonable in cost and does not involve building complications. If desirable, by a suitable cradle arrangement it can be used for removal of a single wheel-and-axle assembly or a wheel-and-axle assembly including a traction motor.

Machine Shop

Aside from the usual quota of machine tools of the type already mentioned the most important single item is a wheel lathe of such size and capacity that it can accommodate a complete wheel, axle, gear and roller-bearing assembly to keep dismantling to a minimum. A wheel press, in addition, will permit changing as well as turning wheels so all of the necessary wheel work may be concentrated at the one point.

Electrical Repair Room

This should consist principally of a clean, dry room with work benches, vises, shelves, etc., for making simple repairs and adjustments to locomotive electrical equipment. Usually the most satisfactory results are obtained by outright replacement of integral items such as reversers, contactors, relays, resistors and small auxiliary motors, but circumstances sometimes necessitate repair of the item involved rather than replacement. In such an event a suitable electrical shop is a requirement. In addition to the conventional testing equipment already noted, it may be found desirable to include a small motor-generator set for furnishing d.c. power at various voltages for relay and regulator testing.

In the event that train-control or cab-signal equipment is used on the locomotive, the necessary maintenance and testing facilities should be added.

Air-Brake and Piping Room

This can combine the usual tools and facilities needed for repairs and testing of air-brake equipment with the few items necessary for steam, air, water and oil line repairs on locomotives. It has been found logical also to include certain specialized Diesel engine accessory repairs with air-brake work so that the air-brake room should also contain facilities for fuel-injection equipment cleaning and testing and for Diesel-engine governor overhaul and testing. It should be emphasized here that repairs to fuel-injection equipment—pumps and nozzles as separate items or combined as injectors, so-called—are not recommended except with special equipment and highly-trained personnel. Usually the manufacturer is in better position to handle anything beyond cleaning and testing of apparatus of this nature.

Sheet Metal, Welding and Blacksmith Facilities

Tools required for sheet-metal repairs are only those necessary for minor repair work on the locomotives, including maintenance of water and oil radiators.

Equipment for electric welding, either in the form of one or more portable welders or a stationary welding set with a number of outlets around the shop is a highly important item for a Diesel-electric locomotive repair point. Equally so are means for acetylene welding and burning and in this case portable outlets are convenient.

As to blacksmith facilities, these can be made as simple as desired since the acetylene torch can be made to do for most bending and straightening of a minor nature such as work on handholes, steps, brackets, clamps, brake-rigging parts, etc.

Several anvils and means for heating such locomotive parts, in many cases, however, may be of considerable assistance.

Lubricating Oil Reclaimer

For Diesel-electric operation on any large scale, reclamation of lubricating oils is highly important since it permits reconditioning of Diesel engine crankcase oil to the equivalent of new oil and at a fraction of the cost. The reclaimer thus prevents waste and provides the maximum of utilization of the oil. In connection with the reclaimer a system of storage tanks for new and reclaimed oil with pump and heating provisions should be installed.

Incidentally, a viscosity measuring device for field determination of this important quality of crankcase oil is very useful in ascertaining quickly and easily in advance of a regular laboratory analysis whether the crankcase oil in an engine should be drained immediately or is satisfactory to continue in service until the locomotive is next in the shop.

Washing Machine

Since provision must be made for exterior washing of Diesel-electric locomotives, particularly those used in road service, a washing machine is worth considering if the number of locomotives justifies it. In any event, a location for washing by machine or manual means must be provided with water supply and adequate drainage. In connection with the general subject of washing, means should also be provided for tanks or vats for removing carbon, oil or grease from Diesel engine and locomotive parts.

Battery Charging Equipment

This is necessary to take care of batteries coming in on locomotives which by reason of characteristics of service or failure of locomotive charging equipment are in need of charging. Hence, the facilities at the repair point should be capable of high-rate charging for short periods or low-rate charging for long periods, the former being used to bring back discharged batteries, quickly and the latter to equalize gravity by means of an extended charge.

Storehouse and Stores

As in the case of the main shop building, the location of the storehouse facilities should be accessible for both rail and highway deliveries of shipments and provision should be made for proper and convenient storage of large as well as small parts. There is no single facility which can be provided that will do more to assist generally in efficient repair work on Diesel-electric equipment than a well arranged storehouse with adequate stores.

Two Schools of Thought on General Repairs

There are today two schools of thought concerning the necessity for so-called back shopping of Diesel-electric locomotives, or in other words, for general repairs to this type of motive power. There are those who maintain that by progressive or distributed use of unit replacement during the life of the locomotives, the need for back shopping can be eliminated together with the excess out-of-service time and expense that may be involved in backshop repairs. There are others who believe that an integrated system of general repairs at definite periods is desirable, which points to the need for a backshop program.

While the answer to the question depends primarily on locomotive design and arrangement, and on the policy of the individual railroads, there are certain general factors which apply to either system.

The first and foremost of these is that from time to time in the life of any Diesel-electric locomotive certain apparatus will require major repairs or replacements beyond the normal routine of current maintenance. For example, Diesel engine crankshafts will have to be reconditioned or renewed occasionally and this will require either engine replacement or engine dismantling and rebuilding. Similarly, main generators and traction motors will require dipping and baking at certain intervals, depending on service, also renewal of commutators and rewinding. Most repairs of this nature require special facilities which, on account of their size and expense, are usually concentrated at one or two points on a railroad. Hence, either the locomotives must be moved to these points or else the integral items of equipment must be sent there and others installed in the locomotives where they are customarily maintained which may entail extra forces and equipment.

A second factor is that a railroad may desire to install a Diesel locomotive repair shop at a terminal combining both terminal and general repair facilities. This, of course, depends on the geographical and operating characteristics of the railroad involved.

A third factor is the extent to which some railroads already have shops equipped with facilities of the general type required for Diesel-electric locomotives. Cases in point are those railroads which already are maintaining electric locomotives or multiple-unit equipment.

A fourth factor is dependence on the manufacturers for replacement or reconditioning of major items of equipment. Here again geographical and policy considerations apply.

In Event of Extensive Repairs

For that class or repairs, therefore, that are heavier and more extensive than the regular inspection and maintenance and which a railroad desires to undertake without particular reliance on the manufacturers, there are two choices available:

(a) Start out new and install the necessary plant and equipment in which case the shop and facilities described under the heading "Locomotive Terminals" need only be enlarged to the extent necessary to include the additional tools and equipment;

(b) Equip existing shop or shops to handle the work by installing what additional tools and equipment are not already available.

Lifting Facilities for the General Repair Shop

In the following such *additional* tools and equipment will be briefly described and comments included as to their application under either alternate.

For better flexibility in use of shop space, overhead cranes for lifting and moving locomotive cabs are desirable though, if the number of locomotives involved is small, a locomotive hoist or a drop table can be made to serve. In the case of the new shop, the addition of overhead cranes would eliminate the necessity for other means for handling truck removals and would, in addition, provide for lifting out Diesel engines or Diesel engine generator sets. As for existing shops, these are usually equipped with overhead cranes and nothing additional would be required.

While on the subject of lifting apparatus, the liberal use of jib cranes strategically located throughout the shop area is recommended to take care of various classes of work requiring more or less continual light lifting attention in order to avoid tying up the main traveling cranes on small jobs. This has already been mentioned in connection with the new shop and existing shops can and should be similarly equipped if Diesel-electric work is to be added.

Presumably the new shop would be constructed solely for the use of Diesel-electric locomotives, in which case the Diesel engine work can be located where most convenient. In the case of existing shops, however, selecting the location for Diesel engine repair work presents a real and a very important problem, particularly if steam locomotive or car repairs must also be handled, for cleanliness and freedom from dust, dirt, chips, smoke, steam, etc., is an absolute requirement for Diesel engine repairs if the best results are to be obtained. It takes no imagination to picture the consequences of subjecting highly polished surfaces or parts operating with clearances as small as half a thousandth of an inch to liberal doses of dust or moisture. Hence every consideration should be given to complete segregation of Diesel engine work, so far as possible, from the rest of the shop.

Machine Tools Needed

Machine tool equipment for either new or existing shops should be equipped with the small items already mentioned for the terminal repair shop, including a wheel lathe, a wheel press and a lathe large enough to handle axles, in order to take care of all wheel, axle and gear work at the one point. This would be additional equipment for the new shop, but in all probability in existing shops would be already available as would other desirable though not necessarily required items of heavy machinery.

Depending entirely on the number of locomotives to be maintained and the extent to which repairs of a fundamental nature are to be undertaken, a crankshaft grinding machine and a heavy-duty cylinder-liner honing machine or grinder may be required. At the present time, however, it is generally felt that a machine large enough to grind crankshaft journals and pins is more in the manufacturers' province if only on account of the large investment required and the relatively small volume of work. In this connection, a small grinding machine for armature shafts, water pump shafts, etc., would very probably be worth serious consideration. As to the honing machine or grinder for cylinder liners, this might be desirable for reconditioning work if warranted by volume. It is apparent that special items of this nature would have to be considered for either new or old shops since it is unlikely that the latter would include them.

Facilities for Electrical Repairs

Unless a railroad is already maintaining electric traction equipment, the facilities for heavy electrical repairs must be considered in relation to either new or existing shop and in relation to the manufacturers, since in this case also the investment involved is large and requires volume of work for its justification. Assuming, however, that it is desired to become more or less self-sustaining the following will be needed in addition to the smaller items already listed for the terminal repair points: a banding lathe for replacing loose bands on general or traction-motor armatures and for banding rewound armatures is a requirement. Usually the necessary wire-band reels and tension-applying apparatus can be installed on an existing lathe. Also a lathe with a fixture for commutator slotting is desirable if this operation is to be handled conveniently and quickly.

A dipping tank for generator and traction-motor armatures and fields with accurately controlled heating equipment for maintaining insulating varnish in the desired temperature range should be installed. A dipping tank maintained at atmospheric pressure can be used but better impregnation results if a pressure or vacuum tank is used. Together with the dipping tank is required a baking oven, also with accurate control of temperature for thorough drying of apparatus which has been dipped. Incidentally, such an oven is of great assistance in drying out electrical equipment that has been flooded or has been standing around exposed to moisture.

While a lathe can be utilized for generator commutator turning, modern traction-motor commutators should be spun and ground under operating temperature conditions to obtain longest life. Turning on a lathe can be used in the absence of spinning and grinding equipment but if there is to be any volume of work involved, the latter is definitely recommended.

Dynamic Balancing Machine

Another machine which should receive consideration if modern equipment in large quantity is to be taken care of is a dynamic balancing machine. This is a practical necessity for high-speed equipment and, in addition to its use for armatures of generators and motors, it can be used for balancing various other rotating parts, such as blower rotors, fan runners, pulleys, shafts, etc.

If winding of electrical machinery is to be undertaken then the usual assortment of benches, stands, brazing and soldering apparatus and other items of miscellaneous associated equipment must be provided.

A full quota of power wrenches, pinion pullers, wooden cradles, small ovens for heating pinions and roller-bearing races, etc., is a necessity for any general dismantling of motors and generators in connection with repairs or replacements.

For such items of electrical equipment as contactors, reversers, relays, motors, etc., it is well to discourage local repairs or testing and to depend instead on unit replacements. The headquarters for general repairs, therefore, must be equipped with the necessary facilities for repairing apparatus thus changed out. These are usually relatively simple and consist for the most part of work benches with vises, miscellaneous tools for dismantling and reassembling and simple test equipment to know the required apparatus is in proper working order, adjustment or calibration.

If welding of Diesel-engine cylinder heads or other parts is to be attempted, either on account of wear of cracks developing in service, then an oil- or gas-fired furnace with pyrometer control is very desirable because the success of the welding depends in large degree on uniformity of heating and careful control of temperature.

Welding and Metal Spraying Equipment Needed

Another maintenance tool of increasing use is a metal spraying outfit for building up worn surfaces of shafts

or other parts where a mechanical bonding of the added material to the parent stock is sufficient and where welding cannot be used.

Still another item of potential maintenance value for certain locomotive parts is flame-hardening of wearing surfaces with control of flame and timing. It goes without saying that the preheating furnace, metal-spraying outfit and flame-hardening facilities can be added to the blacksmith equipment of the new shop if desired and to existing shops if not already on hand.

Along with the battery-charging equipment already mentioned, a small battery room for making minor repairs to locomotive storage batteries such as cleaning, transferring elements, re-traying, adjusting of gravity, etc., together with means for charging and discharging at various rates and for maintaining spare batteries in a fully charged condition, should be provided for a new shop and is usually to be found in existing shops of any size. Repairs to batteries beyond the capabilities of facilities such as these it is believed are as a rule best handled by the battery manufacturers at their own plants or service stations.

At definite though rather extended periods, it is necessary to repaint locomotives, and facilities for this are generally available in the larger existing shops. In installing a new shop, however, provision should be made for at least a small paint and glazing room and possibly a booth for the spray painting of complete locomotives. Whether or not the latter is justified is again a question of the number of locomotives involved.

In existing shops carpenter and upholstering facilities are usually available and in setting up a new shop simple tools and supplies for repair work of this nature should be included, probably in combination with other facilities of special or intermittent use.

Testing Facilities Should Be Provided

Finally, in the case of either a new or existing shop for general repairs, testing facilities should be provided in the way of Diesel-engine exhaust-gas pyrometer, maximum pressure indicator, tachometer, rheostate (either water or resistor type) for artificial power-plant loading, electric meters, etc.

From the foregoing it can be seen that for Diesel-electric locomotive maintenance a terminal shop for handling inspections and running repairs including light periodic work and a general repair shop or so-called "back shop" for handling the heavier periodic work are basically similar. The only difference between the two is the extent to which one shop can handle heavy repairs as compared to the other. Putting it another way, any adequately equipped terminal shop can handle heavy repairs with a minimum of additional equipment and conversely, any existing back shop, particularly if it is fitted for handling repairs on electric rolling stock, can quite easily take on Diesel-electric repairs. The reason for this similarity is, of course, that the motive power equipment of a Diesel-electric locomotive is principally an assembly of relatively small, easily replaced parts.

It is also apparent in the descriptions which have been given that they represent a plant to work to and ultimately to complete but that if necessary the facilities mentioned can be obtained and installed progressively as the number of locomotives increases and their age advances. In nearly all instances railroads have facilties already in existence at various points and until the Diesel-electric headquarters are finally completed and centralized, items of locomotive work of various classifications can be farmed out to such facilities.

Central Repair Points Desirable

In conclusion, however, it should be stated that the quicker a central point or points, depending on the size of the railroad, can be set up for Diesel-electric locomotive repairs, the quicker will the best results in the operation of such motive power be obtained.

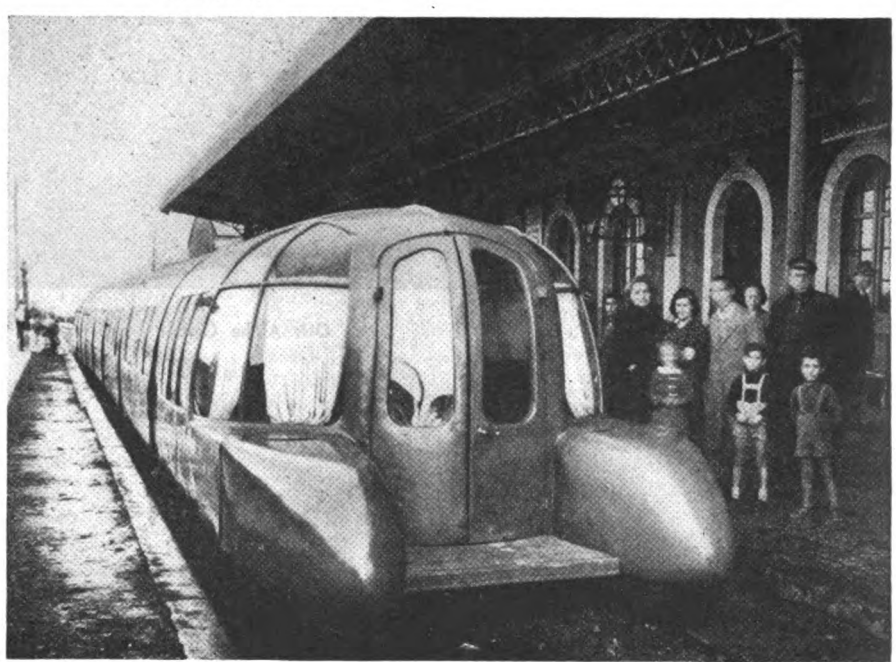
The same conclusion applies with equal force to maintenance material and spare parts for Diesel-electric equipment. Granted that these must be located at points in the territory where the locomotives operate, nevertheless, some central point or points, again depending on the size of the road, for all Diesel-electric stores is very desirable.

This would constitute a supply base for the outside points and in it should be maintained master stock lists and ordering information and a complete supply of all parts in the proper quantities. Also, in cooperation with the maintenance shops and the manufacturers, a system of repair and return can be set up to recondition and reutilize Diesel-engine, locomotive and other parts subject to replacement in service.

* * *

SPANISH TRAIN WITH LOW CARS WEIGHS 2,850 LB. PER WHEEL.—A streamline Diesel-powered train has been developed in Spain where it is said to have maintained a speed of 80 m.p.h. on sharply curved lines where a regular train could not exceed 31 m.p.h. A reduction in dead weight was effected in part by adapting airplane technique to the building of the carriages, with stressed skin structures and light alloys, and by adapting motor-car technique to the independently sprung wheels, suspensions, and braking systems.

The train is composed of short units, with a very low center of gravity and low overall height above the rails—7 to 8 ft. The car floor has a clearance of only 12 to 14 in. above the rails. The wheels have been made independent by eliminating the axle between each pair. Each car has two wheels at its rear end, each sprung independently from the car body frame. The front end is linked for transaction to the next car body. The train, including passengers, is said to weigh 5,700 lb. per pair of wheels—less than 200 lb. per passenger.



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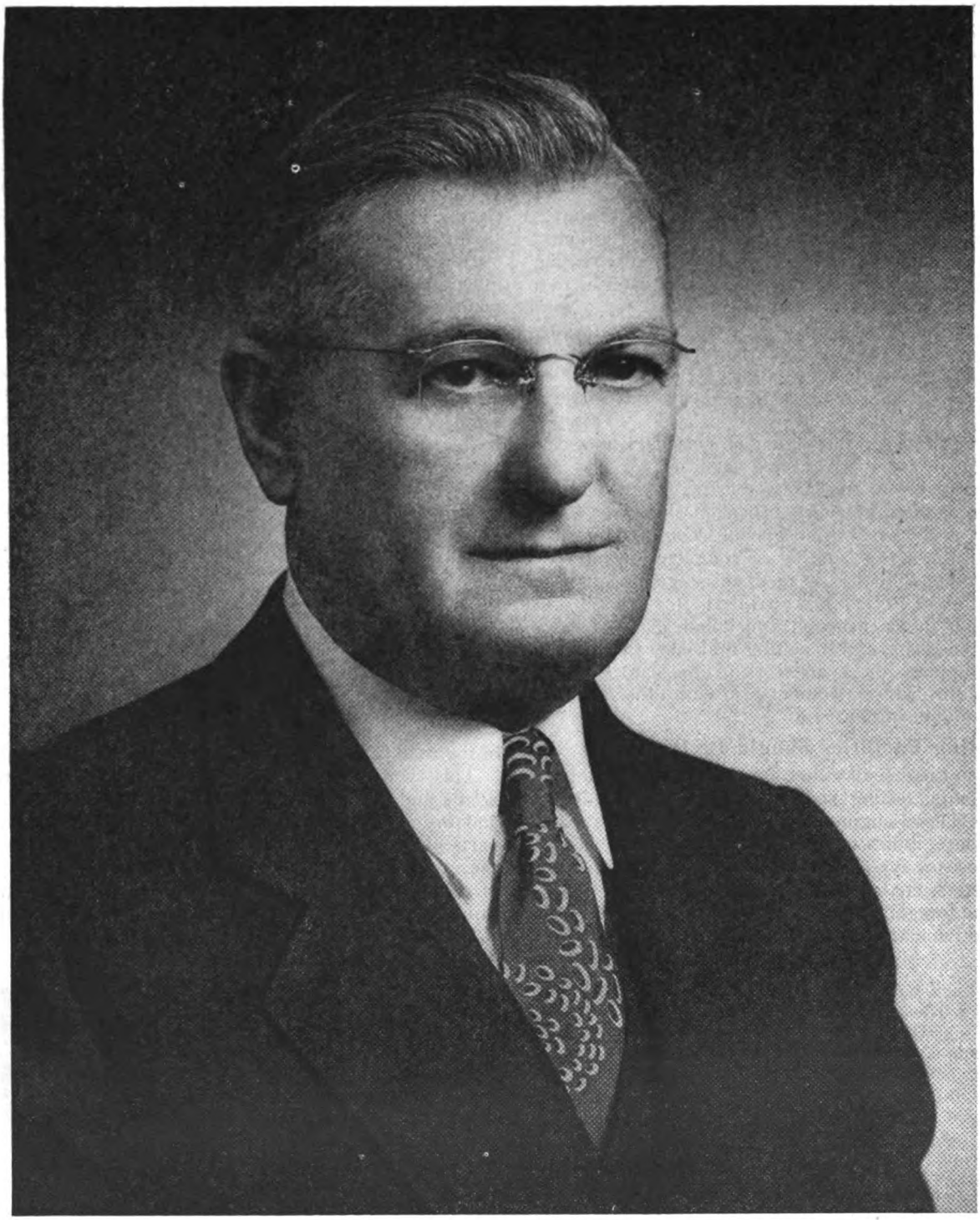


Otis Alpha Garber

Past-Chairman, Mechanical Division

Otis Alpha Garber

Mechanical department chief of Missouri Pacific Lines noted for rare administrative ability and thorough understanding of technical phases of department

THE Missouri Pacific Lines, including the Gulf Coast Lines and the International-Great Northern, form a sizable railway system on whatever basis it is gaged. With its network of lines in Missouri, Kansas, Arkansas, Louisiana and Texas, it reaches out over their borders into several neighboring states. Serving the three principal transportation gateways on the Mississippi river—St. Louis, Mo., Memphis, Tenn., and New Orleans, La.—its rails extend westward as far as Pueblo, Colo., northward to Omaha, Nebr., and southwest to Laredo and Brownsville, Texas, on the Rio Grande bordering Mexico.

For the year 1943 it ranked seventh among the railroads in this country in operating mileage, eighth in total operating revenues and ninth in maintenance of equipment expenses.

Otis Alpha Garber has served with distinction as its chief mechanical officer since October, 1926—a range of 18 years. He has been a member of the General Committee of the Mechanical Division, A. A. R., since 1928 and was its chairman in 1935-36. He is a member of the Advisory Board of the Locomotive Maintenance Officers Association. What is his background? Where did he get his start in railroading? By what route did he achieve his present position of responsibility and influence? What are some of his outstanding traits and characteristics? The following appraisal is based on the statements of a considerable number of men who have worked with and dealt with him more or less intimately over the years, going back to his school days and railroad shop apprenticeship.

Mr. Garber was born on a farm in Auburn, Sagamon County, Ill., October 15, 1874. His family moved to nearby Springfield when he was about ten years old. He attended high school for two years and according to one of his schoolmates, was a good scholar. Apparently he had a strong desire to earn his own way and after school hours worked in a small store. He spent occasional vacations with his grandfather who had a workshop, and enjoyed greatly working in it with him. From a couple of discarded wheels he made a sulky and then fashioned the harness. As a boy he liked to take clocks and other mechanical devices apart and reassemble them. He seems to have had a natural bent for mechanical details.

Starts His Apprenticeship

As a boy Otis was not particularly interested in railroads. As a matter of fact, he was never in a railroad shop until he started to work as a machinist apprentice in the Springfield shops of the Wabash in 1891. Two of his friends, somewhat older in years, were apprentices and it was possibly only natural that he should follow in their footsteps. He is said to have learned his trade rapidly and incidentally acquired an excellent knowledge of air brakes and their maintenance—a valuable asset at that time.

It is said that while he was working on the air brake bench at Springfield a locomotive, just turned out of the shop, developed a hot main rod bearing. The rod men were called upon to ascertain the cause. They failed to locate the defect and the general foreman sent Otis to see what he could do. As he was looking over the locomotive a wiper known as "Mud Turtle", suggested that he measure the tires. This he did and discovered that one was larger in diameter than the others. The wheels were dropped, the tires re-turned and the trouble eliminated. Otis got the credit and it is said he never forgot the tip given him by "Mud Turtle".

At the End of Ten Years

In summing up his ten years of service on the Wabash it may be said that he learned his trade thoroughly and was regarded as one of the best general mechanics in the shop. Ever on the alert, and giving careful attention to the details of his work, he was at the same time well liked by his associates because of his pleasing personality.

One of his early cronies who has kept in close touch with him through the years remarked recently that "Otis could never stand slovenly work or slip-shod methods. Even when he was laboring night and day mastering the details of shop work he found time to keep neat and clean and was as particular about his appearance as he is today. It's just second nature with him to always be well dressed, just as it is second nature with him to look into shop corners for dirt and rubbish and to rail against what he terms 'bad housekeeping.' "

Apparently the prospects on the Wabash did not appear attractive and in 1901 he left that road to become erecting foreman, and then roundhouse foreman for the Baltimore & Ohio at Lorain, Ohio. On April 4, 1903, he entered the service of the Illinois Central at Paducah, Ky., as a machinist, advancing to gang foreman and then roundhouse foreman. This period marked the beginning of the second phase in his development and experience in the railway mechanical department. The general foreman soon discovered that he was not only an outstanding mechanic, but that his ability, judgment and personality fitted him for a supervisory position.

In April, 1909, he was promoted to general foreman at Mounds, Ill. A friend of some experience suggested that he run the job and resist interference from outside his department. He did just that and later was highly commended by a transportation officer, who said that when Otis came to Mounds, "light, thin and pale-faced," they did not expect to see him last long. To the officer's surprise they soon discovered that he knew his business thoroughly and also understood how to take care of himself in an argument.

In April, 1911, he was transferred to Paducah as general foreman, remaining in that capacity for one year. Here, again, an emergency demonstrated his ability as an organizer and leader. In the 1911 labor difficulties the railroad lost every mechanic and helper at Paducah. Great

responsibility devolved upon the general foreman in recruiting and reorganizing the forces and Mr. Garber gave an excellent account of himself. In March, 1912, he was appointed master mechanic at East St. Louis, Ill.; in October, 1918, he was transferred in a similar capacity to Waterloo, Iowa, and in January, 1919, to Memphis, Tenn.

Goes to Missouri Pacific

Among those who had observed in Mr. Garber up-and-coming tendencies and who knew he possessed the grit, determination and the know-how necessary to successfully carry a heavy load was L. W. Baldwin. After serving as regional director during the period of Federal control, Mr. Baldwin became operating vice-president of the Illinois Central, but in 1923 left to become head of the then not so healthy Missouri Pacific. In 1925 Mr. Garber was invited to join its ranks as mechanical superintendent and first assistant to W. H. Fetner who was chief mechanical officer.

The Missouri Pacific had been hard hit by the shopmen's strike in '22. The morale of its mechanical forces was not high. Efficiency standards were not at a satisfactory level, and its power, rolling stock and shops all pointed the need for modernization and rehabilitation. Some of Mr. Garber's friends urged him to think twice. "Why take a chance?" they asked. "It's a graveyard for good mechanical men. You'll work yourself to death and get no place for your trouble."

To all such advice Mr. Garber turned a deaf ear and a smiling countenance. "Where," he asked, "did you get the idea that I was afraid of hard work or for that matter who says hard work will kill anyone? And what if the property isn't in the best of shape," he added, "it'll be fun to build it up." That it would be built up he had no doubt, for while Mr. Baldwin had been noting things about Mr. Garber that he liked, Mr. Garber had been observing the tactics of Mr. Baldwin. "I figured the Missouri Pacific was on its way up," he explains, "and I knew I'd like working for L. W. B. and time has proved me right on both points."

He went at the task methodically and with his accustomed thoroughness. The first step was to inspire teamwork among the mechanical department supervisors. This he did by working on them, two at a time, until good understandings had been engendered among the entire mechanical supervisory staff and a high standard of cooperation cultivated.

Third Phase of His Career

On October 1, 1926, he was made chief mechanical officer, in which capacity he has functioned ever since. This last period covers the third phase of his railroad career. It will be recalled that in 1922 the railroads, hampered by periodic congestions and still suffering from the McAdoo Railroad Administration, which had functioned during and following the first World War, individually and collectively put on campaigns for increased efficiency and effectiveness of operation. This did much to bring them back into public favor, despite the growing competition on the part of highway and airway carriers.

Mr. Garber, with his natural aptitude and thorough training in mechanical affairs, and his ability to organize and lead men, used these talents to excellent advantage in improving mechanical department efficiency and operation. This was one of the factors that helped the mechanical department of the Missouri Pacific to weather the depression of the 'thirties and to be in a position to give a good account of itself when the Southwest faced into the heavy traffic stress of these war years. His efforts were in no sense dramatic; rather there was a steady, consistent, hard-hitting effort to build up the organization and its morale and induce a maximum co-operation, both within the department and in its relations with other departments.

What about his relations with his associates in supervisory positions and with the workers in the ranks? How did he induce this co-operation and establish that high standard of morale which is characteristic of his department? What about his mechanical ability and the improvements made in the mechanical equipment and facilities during the years that he has headed up the department? The answer to these questions will tell the rest of the story.

Leadership Ability

Having worked his way from the very bottom to the top of the mechanical department he is familiar with all of its details. Not only does he know how to do them, but he has the ability to explain processes clearly and concisely and, if necessary, to demonstrate them. His associates understand this and therefore have confidence in his judgment and leadership. Not only does he know the details of the jobs and how to perform them, but he understands human nature and how to deal with it. That is a combination that makes for real leadership.

If we try to get behind his personality we find his associates emphasizing certain features. He is, for instance, two-fisted, competent and a square shooter; has a saving sense of humor; has a pleasant personality which inspires confidence; is kindly and considerate of others, yet firm, with high moral courage; is tolerant and carries no grudges; is dynamic and colorful; is popular and well liked. It must not be imagined from all this that he is a "softy". Rather, in a sense and in the words of one of his associates, he is a "gentleman of the old school." Not that he is old, even though he is approaching retirement age, for he has a youthful, progressive viewpoint and looks to the future with enthusiasm. But rather, he has that fine courtesy which we associate with the old school, but which at the same time, is coupled with a dignity and firmness, when required, that is respected and cannot be misunderstood.

Just as a successful teacher is patient and tolerant, so Mr. Garber has a keen feeling of responsibility for the development of those under him, and will go the limit in trying to help bring out a man's latent talents. On the other hand, he has no patience for carelessness. "Yes, he is tolerant," commented an associate, "as long as you do not make the same mistake twice."

He encourages men to make suggestions and deals with his associates in cordial friendliness, yet exacts a high standard of performance at all times. Or on occasion this process may be reversed. For instance, he may arrive at a local point and put in an entire morning of criticism, all constructive. At about the time the local officer begins to feel that his stock has dropped way below par, the Chief will say, "Well, Blank, you should be hungry by now. Come down to the Car (business) and have a good dinner." By the time he leaves town the local officer will realize that the Chief was right in his criticisms and will be more than willing to follow his advice.

Different types of men must be approached and handled in different ways. Mr. Garber has the ability to delegate responsibility and make men feel the importance of his responsibility. It may be that a master mechanic, faced by unusual difficulties, has experienced two or three delays in his territory during a 24-hour period. Mr. Garber is quite likely, personally, to call him on the telephone and something like the following conversation may take place.

"Is this you, Tom?"

"Yes, Mr. Garber."

"You are having entirely too damn many delays on your railroad. That's all I have to say."

"Yes, Sir. Good-bye, Mr. Garber."

It is said to be surprising how often this method of approach gets the job done. Those who have worked with him know that there will be no second phone call and that the delays must stop. It is done in such a way, however, that they feel the Chief has confidence in their ability to make good and they tackle the job with renewed confidence and energy.

Mr. Garber has always taken a keen interest in the younger men in his organization and has consistently carried on an apprentice training system through good times and bad. He has accepted the fundamental principle that if you are to have apprentices when you need them in good times, their training must be started four years earlier, even though that is in a period of depression. If, on the other hand, apprentices are graduated during a depression and cannot be absorbed in the organization immediately, they are assisted to get work elsewhere. Such boys, however, are kept track of and are invited back to the railroad at the earliest possible moment when a place can be found for them. It is not surprising that many of the graduate regular apprentices have advanced to important supervisory positions on the Missouri Pacific, as well as on other railroads.

Relations With Workers

Mr. Garber has the record of being open and fair-minded in his dealings with the workers and believes in giving every man every possible opportunity to develop his personality and talents. He recognizes that if we are to continue raising the standards of living, machinery and labor-saving devices must be introduced to take over the laborious manual work, thus multiplying the output of the individual and making production and services more widely available at a lower unit cost. In this way the purchasing value of the dollar is increased.

It is said that a shop mechanic insisted that because of the introduction of improved machinery he was doing two days' work in one, and that this condition was not fair. Mr. Garber's reply was that anything that can be done in a day's time constitutes a day's work.

A labor leader, who has known him for several years and has sat across the table from him in numerous conferences, sizes him up in this fashion: "He is kind and considerate, yet he can cuss you out with the best of them, and when he does you go away feeling that you probably had it coming. His word is good and he hates a liar. He has the complete confidence and respect of his employees and I do not believe there is a man on his railroad who would let him down. That, in a nutshell, is the employees' honest opinion of Otis A. Garber."

Mr. Garber is a strong advocate of safety first principles, mainly from the humanitarian standpoint, but he also recognizes their importance with respect to conservation of manpower. He has unusual sympathy for those in trouble, and invariably is among the first to visit the sick and injured, either in the hospitals or in their homes. He is a bit critical of a doctor who may release an injured shop man with authority to return and perform light work. When will doctors learn there is no such thing in a railroad shop or enginehouse—it is all heavy work!

Dealing With Supervision

Mr. Garber has made a hobby of building up and organizing the employees to carry out their work with a high degree of efficiency. This has brought to the front in supervisory capacities men who might otherwise not have had an opportunity to demonstrate their worth. Incidentally he believes in the practical value of railway mechanical associations and encourages the members of his staff to participate in their activities.

He has taken unusual care in the selection of staff officers, master mechanics, shop superintendents and shop supervisors. While he feels strongly that the master mechanics and shop superintendents should make the selection of the supervisors under them, he requires, before approving such appointments, that the names of more than one man for a position be presented to him, with complete details about their history, education,

Mr. Garber being congratulated by H. E. Roll, personnel manager, when the mechanical department was first to reach 100 per cent in the Fifth War Bond Drive

Mr. Garber watching a World Series baseball game in St. Louis

training and previous experience in a supervisory capacity, and he reserves the right to appoint a second or third choice.

His office door is always open to supervisors and employees to discuss their problems, suggestions, grievances, or what not. One cannot but be impressed with the deep sense of loyalty to him, and through him, to the company, on the part of members of his staff. A former associate, who has taken an important position on another railroad, in commenting on this trait, said with a burst of profanity, that, "If the Chief had asked him to jump over the blacksmith shop he would break his fool neck trying it." Let no one infer, however, that Mr. Garber would make such a request. With his keen and thorough knowledge of mechanical practices and human nature, and his ability and habit to make a quick and accurate analysis of a problem and come to a decision, his requests, though they may be difficult of accomplishment, are eminently practical and purposeful.

And Mr. Garber does have a thorough understanding of the mechanical department and its operations. This was most forcefully demonstrated a few years ago when a Reconstruction Finance Corporation group made a trip over the Missouri Pacific. The representative from Jesse Jones' office, who studied the mechanical department situation, had a rather lengthy list of detail information that he desired. He presented this list to Mr. Garber on the second day of the trip over the road and said: "I realize that this is a long list and involves a lot of work. There is no hurry about it, but at your convenience I would appreciate the information." Mr. Garber looked it over and said he thought he had all the information on the car, with the possible exception of one report which might not be complete for the current month. The R. F. C. representative was rather doubtful if Mr. Garber understood the scope of the information requested. Within a couple of hours complete data requested were presented to this representative, much to his astonishment.

Not only does he keep pertinent information about mechanical department equipment and operations up-to-date and conveniently at hand, but to the occasional embarrassment of some of his associates, he has an uncanny ability of remembering facts and details, and a keen eye for detecting defects in equipment.

Equipment and Plant

The Missouri Pacific has not been in a position to make as heavy capital expenditures for new facilities and equipment as it would have liked. Mr. Garber has lost no opportunities, however, to have studies made of new devices, new methods, or improvements in old ones. In rebuilding and modernizing locomotives, roller bearings have been applied, as well as light-weight reciprocating parts, light-weight pistons with sectional packing, and other devices that seem to have possibilities for more efficient performance. Boiler steam pressures have been increased wherever possible, and the locomotives have been recounterbalanced in order to increase the speed at which they could be operated.

It is not surprising to find that the Missouri Pacific was quick to purchase Diesel equipment for streamline trains, as well as Diesel road freight and switching locomotives. To service and repair the Diesel road freight locomotives a new lay-out has been installed at Dupo, Ill.

While no major back shop has been built in the past twenty years, machine tools and shop facilities have been modernized to a high degree, special efforts being made, also, to eliminate the manual handling of material so far as possible. Each shop, enginehouse or repair track is thoroughly equipped with lift-truck tractors, crane trucks, skid boxes and efficient layouts of runways for moving material in the most economical way.

A characteristic incident that shows Mr. Garber's ability to adopt new ideas is related by a friend. Questioned about a special truck for handling lumber and other materials, Mr. Garber said, "Oh, these are not new. We use them in several places and they sure do a swell job. The first one I ever saw was on a highway in California several years ago, when I was on a vacation. I didn't know what it was and pulled my car to one side to let it pass, but the minute I looked it over I said to myself, 'By golly, that would speed up the handling of material piles, as well as other jobs.' I called to the driver to stop, but he didn't hear me. The place that I had stopped was too narrow to turn, so I had to keep on for a while before I could head back in the direction the lift was going. Finally I caught up with it and flagged the driver to stop. He told me how it worked and what it would do. I climbed over it and got the name of the manufacturer, and wrote to the office to get all the dope on it and the price, so that I could order one when I got back."

At the more important engine terminals the roundhouse stalls have been lengthened, additional long stalls added, and up-to-date machinery and facilities installed for the prompt turning and repairing of locomotives. The major installations of this type are located at St. Louis, Mo., Kansas City, Mo., Omaha, Neb., Ossawatomie, Kan., Atchison, Kan., and one at Dupo, Ill., is now under way.

At Sedalia, Mo., a complete spring shop has been installed in a separate building, with the necessary machinery, furnaces and testing equipment for the efficient repair and manufacture of springs for locomotives and

passenger cars. As a result of improved material used and the method of handling and heat treating, the percentage of spring renewals is very low, compared with what it was before these operations were centralized. A reclamation plant has been installed at Sedalia, which is well equipped to do miscellaneous reclamation work not ordinarily done in other shops. An efficient scrap handling plant is being installed at Sedalia.

Locomotive Failures

A testing organization has been set up to check and inspect materials and test various devices. The installation of water treating plants, with an efficient organization in charge, has resulted in material improvement in the condition of boilers and a decrease in the renewal of firebox and boiler sheets. On fireboxes, for instance, the life of sheets has been more than doubled in the past two decades.

Studies are constantly being made to improve materials or the designs of such parts of locomotives as cause failures. Each failure is thoroughly analyzed. In 1923 there were 2,424 locomotive failures, or an average of 14,121 miles per failure. The peak performance was reached in 1930, with 163 failures, or an average of 225,541 miles per failure. Conditions in 1943 were naturally far different from those in 1930, with the war on, many up-graded mechanics, a shortage of power and the necessity for its quick turning. In that year there were 295 locomotive failures, or an average of 135,327 miles per failure, which, considering present conditions, is an excellent record. Mr. Garber discusses each and every failure with his master mechanics, shop superintendents and staff officers at the monthly meetings.

He believes it is the responsibility of the management to see that every man is thoroughly informed and trained for his task. In addition to the apprentice training and staff meetings for the supervisors, already referred to, the company operates an air brake instruction car and also a fuel conservation car, which has recently been fitted up and which is equipped for the showing of movies with lectures and opportunity for open forum discussions.

The company now operates about 70 Diesel-electric locomotives and the necessary instruction is provided for the training of mechanics working on this equipment and for checking its mechanical condition.

All of the main line passenger equipment is now air-conditioned. Coaches have been modernized to include modern type seats, with attractive lounge rooms, washrooms and smoking compartments. Special emphasis is placed on the thorough cleaning and servicing of passenger-carrying cars at terminals, in order that they may be maintained in a clean, sanitary and attractive condition. Frequent checks are made to insure that this service is maintained at a relatively high standard. The Missouri Pacific has recently ordered 25 aluminum alloy hopper cars of 70-tons capacity.

Helping Friends

The following incident is said to be characteristic of Mr. Garber's interest in his friends and is told in the words of the superintendent of motive power of another railroad:

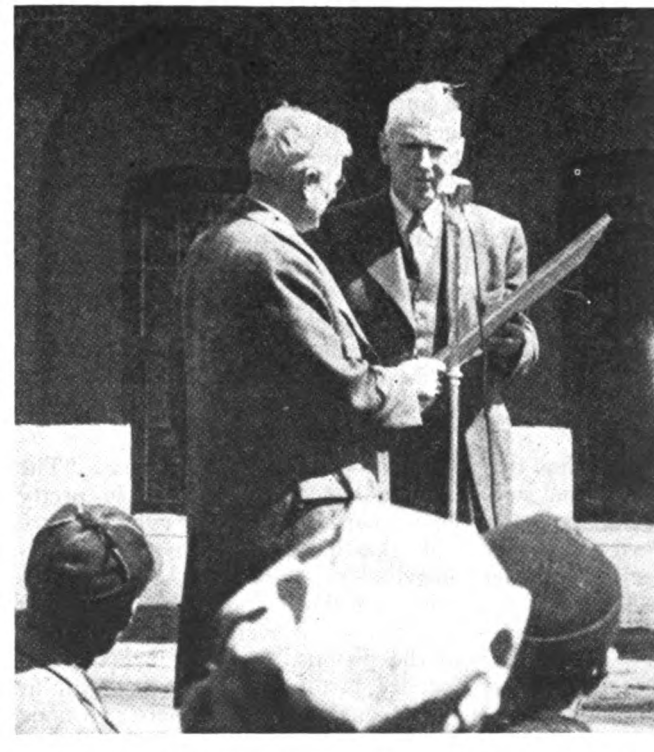
"When I was made superintendent of motive power, I was only 37 years old. Otis Garber called me the second day after I was appointed and gave me an order to meet him in St. Louis with my bags packed for a two-weeks trip over his railroad. Just being appointed to the position I, of course, did not think I could get away in such a short period of time and spend any time off the railroad before getting organized. Fact of the matter was, Otis won out and I made the trip over his railroad, which he made specially on my account to 'rub my nose' into the executive end of the mechanical department. Over each division he had his key officers accompany us, taking me through all of his shops and storehouses and acquainting me with their shop practices, etc. He even went so far as to hold a meeting with the labor organizations, permitting me to sit in with him to see how he conducted meetings of this nature."

Hobbies and Recreations

Mr. Garber is fond of fishing and hunting, and his occasional trips into Texas have gained him the title of "Big Game Hunter"—he has bagged large game as well as small. Baseball is his real hobby and he follows the fortunes of the Cardinals and Browns with keen zest—yet he seems to get as much enjoyment out of an amateur game on the sandlot, as from the professional games. He is a 32nd degree Mason and a Shriner.

In Conclusion

The story has been told—at least the facts have been assembled and speak for themselves. Linked up with the stories of McCormick, Hankins, Nystrom, Flynn and Henley, it would appear that there is no single, well marked course to the leadership of the mechanical department of a railroad. And yet there are some well defined and outstanding threads in the pattern of the fabric of leadership. These men do have certain traits in common. A keen understanding of human nature, a sympathy for their fellows and the ability to select and develop men of leadership ability, an ample supply of common sense, a thorough training in the details of departmental activities and the ability to analyze a problem and make prompt decisions—these are some of the common qualities which seem to be outstanding.



Mr. Garber presenting safety award to W. B. Shea, shop superintendent at DeSoto, Mo.

A SCRAPPY JOB

by Walt Wyre

THE superintendent of motive power complimented Jim Evans, roundhouse foreman for the S. P. & W. at Plainville, on the job he was doing getting locomotives out, but the official wasn't quite so complimentary when he noticed the pile of scrap that had accumulated.

"I'll be back in three or four weeks," the S. M. P. said, "and I don't want to see even a handful of metal shavings on the scrap dock."

"O.K.," Evans agreed, "I'll try to get it loaded right away if I can get a car set in for loading it."

A car for loading the scrap was set in the following Monday morning. Evans told the operator of the portable gas-electric crane to get a couple of laborers and load the scrap.

"There's a set of rods for the 5094, an air pump to change on the 5097, and a carload of wheels to unload," the crane operator reminded Evans. "Which do you want me to do first?"

"Maybe you can get started loading the scrap first thing tomorrow." The foreman scratched his head thoughtfully and started to walk away.

"You know the gasoline motor on the crane is in pretty bad shape," the crane operator said. "When do you figure on having it fixed? The number two cylinder pumps oil so bad it takes half of my time cleaning spark plugs and the rod bearings are so loose they rattle like a Jap's knees when he sees a Marine."

"Well, we can't tie the crane up now—maybe in a day or two." Evans turned and went into the roundhouse.

Next morning there was a set of driver tires to be handled. Evans told the crane operator to start loading scrap as soon as he finished unloading the tires, but the crane engine changed the program. Half of the tires were unloaded when one of the connecting rod bearings started hammering like a boilermaker in a hot firebox calking a leak.

Evans decided to send the motor to a local shop to have it overhauled as there were no facilities in the railroad shop for doing the work. He found electrician Ned Sparks and machinist Bob Jenkins and told them to remove the power unit from the crane. The manager of the shop told Evans he could have the engine ready to go in a couple of days.

NEXT day the repair shop man called Evans. "The motor you sent down to have overhauled is in pretty bad shape," the repair man said. "The cylinders are worn so much it will take thirty-five thousandths oversize pistons after the cylinders are bored."

"O.K.," Evans said, "go ahead and bore them. Can you have it finished by tomorrow evening?"

"I could if I had the pistons," the repair man said, "but the largest oversize pistons I've got that will fit that motor are twenty-thousandths, and there are none in town. I'll wire Kansas City for some pistons. If they ship them right out they should be here tomorrow and we can finish the motor the next day."

"All right," Evans replied, "get it finished soon as you can. We sure need the crane."

In the meantime, electrician Sparks was overhauling the crane motors and renewing the wiring. The hoist motor particularly needed cleaning, the commutator turned, and some new brushes. Sparks was working on the motor when the foreman came up.

"About finished with the electrical work on the crane?" Evans asked.

"No," Sparks said, "it will take quite a bit longer. I'm figuring on taking the traction motor out and cleaning it good."

"Maybe you had better work overtime tonight and get it all ready. We should get the engine tomorrow," Evans told Sparks.

The engine wasn't ready next day. In fact, it was no nearer finished than it had been the day before. The supply house in Kansas City had wired that no pistons thirty-five thousandths oversize were available for the crane motor.

THAT night Sparks was working on the traction motor when Ed Simpson, the second trick electrician, came into the electric shop all out of breath. Ed had only been with the company about four months. He seemed to be a pretty fair electrician and had had some railroad experience.

"The 5093 has a dead ground in the wiring," Ed said, "and I'm not having any luck finding it. She's a three months' test; they are figuring on running her about eleven o'clock."

"Are you sure the ground is in the wiring?" Sparks asked.

"Yes, pretty certain," Simpson replied. "I disconnected the dynamo and tested."

"O.K.," Sparks agreed. "I'll see what we can find. Is the Megger out there?"

"Yes," Simpson said, and added, "I've disconnected all the cab fixtures and tested them."

"Did you test the wiring in the conduit on top of the cab?" Sparks asked as they walked through the roundhouse.

"No, but I tested the wiring to the headlight and classification lights from the junction box where the conduit from the dynamo connects with the hand rail."

"That eliminates the stack light, too," Sparks said, speaking as much to himself as to Simpson. "Looks like the conduit on top of the cab might be the next best place to look."

The two electricians climbed up on the roof of the cab. Sparks removed the cover from the first condulet in the conduit run and disconnected the wires. He connected one lead of the Megger to one of the wires and grounded the other lead. Simpson cranked the Megger.

"It's not here," Simpson announced.

"Well, it must be somewhere else," Sparks grinned when he realized how silly the observation sounded. "I'll test the wires coming in."

The hand went to zero when the Megger was cranked and Sparks scratched his head. "You' haven't tried the wiring to the back-up light on the tank, have you?" Sparks asked. "The ground could be in that or else in the flexible conduit between the engine and tank. If you'll go down and disconnect there, I'll connect and tape these wires and put the cover on the condulet."

The wiring to the back-up light showed almost a megohm resistance to ground and Sparks was beginning to be more than slightly puzzled.

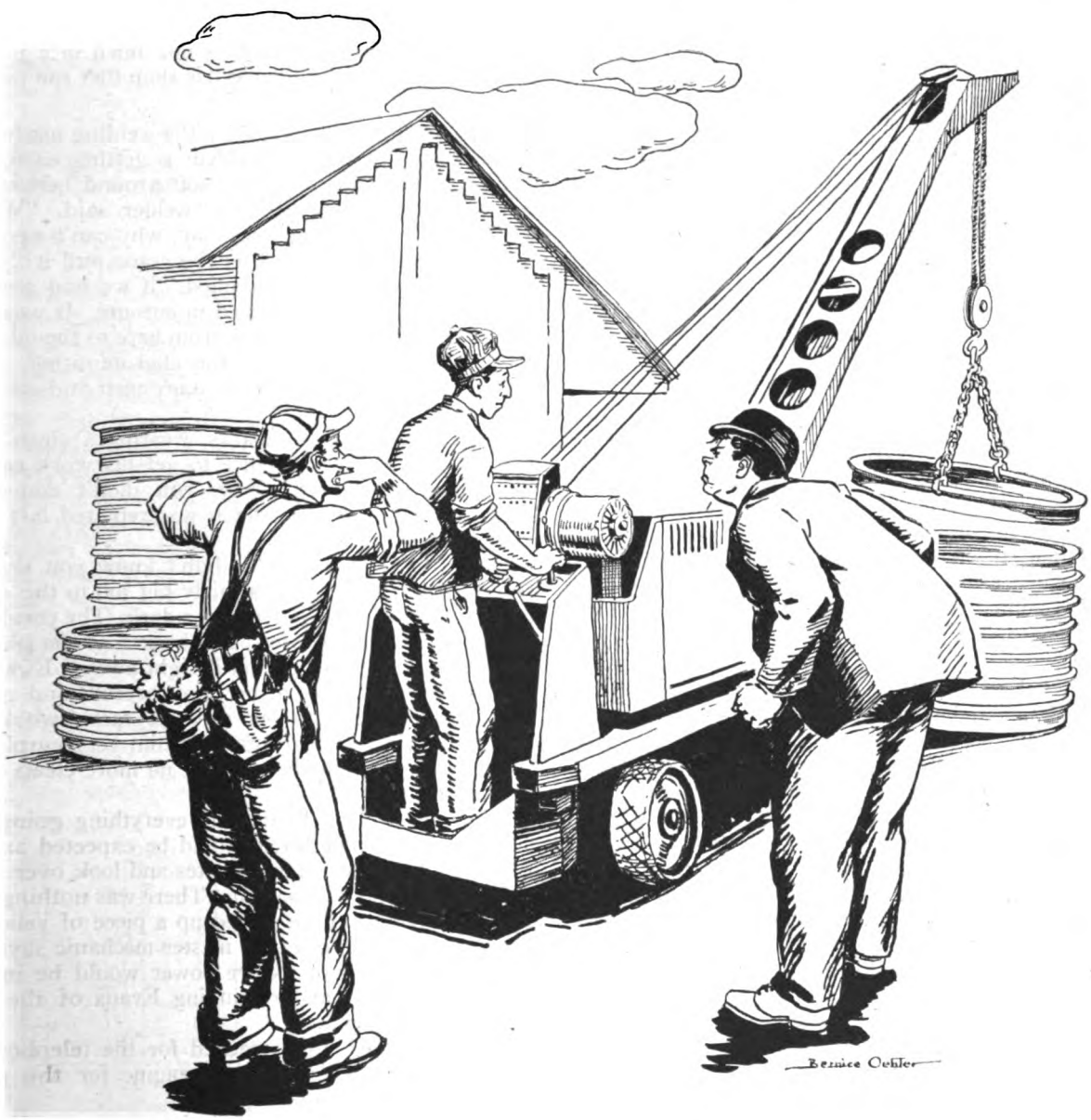
"That's all of it except in the cab. It could be in the wiring to the automatic blow-off. Did you test that?"

"No," Simpson replied.

"Well, guess I should have looked at it," Sparks remarked as he started back to the electric shop.

FIVE days went by and still no pistons for the portable crane motor. Evans had known all along that the crane was a very useful piece of machinery but never before had he realized how many jobs the crane had been used for and it seemed like it was needed more than ever before. There were rods to remove and replace, air pumps to be changed, pistons to pull and replace, driving wheel tires to handle, draw bars to remove, then the pile of scrap was still waiting to be loaded.

Monday morning, one week from the day the crane had quit, one of the electric welders went temperamental.



A connecting rod bearing started hammering like a boilermaker in a hot firebox calking a leak

"Did you disconnect the wires to the panel?"

"No, I figured it all looked too new to be giving trouble, but it could be grounded," Ed said thoughtfully.

"Could be!" Sparks almost yelled. "One side of the circuit is permanently grounded. No wonder we couldn't clear the ground!"

"Now ain't I dumb!" Simpson said. "I knew there was a ground connection in the panel."

"Can't seem to keep the blamed thing regulated and it won't work hardly at all with the positive side grounded," the welder operator explained.

"When did it start doing that way?" Sparks asked.

"Oh, it's been acting sort of crazy three or four days, but it just got so bad today I can't use it."

"Well, if you and your helper will help me pull the

welder to the electric shop I'll see if I can fix it," Sparks said.

"Why don't you get the portable crane to pull it?" Then the welder operator remembered. "O. K., we'll help you get it to the electric shop."

"Looks like a little cleaning and a coat of varnish on the windings wouldn't hurt," Sparks observed when the machine was in the electric shop. "Guess now is as good time as any to do it."

"How long will that take?" the welder operator wanted to know.

"Well," Sparks thought a moment, "if I'm not interrupted with too many other jobs I should get it done today, but I can't promise."

The first thing Sparks did was to test the machine to see if it was grounded. It was. He decided to tear it down before making any more tests to see where the ground was located. The commutator needed turning and the windings needed cleaning and a coat of insulating varnish. The lower field coils particularly had accumulated grease, grime, and dirt. After the machine was disassembled Sparks again Meggered the windings and found the shunt field to be grounded on one of the bottom coils. Vibration had caused the insulation to wear away, leaving the wire bare. The welder would have been ready to go that afternoon if a new hostler helper had not given the hostler a go-ahead signal without removing a fuel oil crane spout from the manhole of a locomotive tank. The result was, to put it mildly, a mess. The crane was pulled over, breaking the pipe at the base of the crane. Fuel oil flowed freely at the rate of nearly a thousand gallons a minute for almost five minutes. Wires leading to the switch on top of the crane were broken and Sparks had to remove the conduit from the crane and disconnect the wires. When he got through he looked as though he had just crawled out of an oil field slush pit.

"And I just put on a clean suit of overalls yesterday!" Sparks moaned as he scraped the gooey mess from his clothes. "If some one would just sprinkle a few feathers on me I'd look like I had been tarred and feathered."

In the meantime, a water service man and helper had come to look at the damaged oil crane and make repairs. "It wouldn't be much of a job," the water service man commented, "if we could braze the pipe. That's all that's damaged. We could just straighten up the crane and braze the break in a couple of hours."

"How long will it take if you can't weld it?" Evans, who had joined the group, asked.

"Oh, I can't say exactly," the water service man paused and squinted one eye like he was aiming a gun at the oil crane, "the better part of a day, I'd say. You see, we will have to take the crane down and cut threads on the pipe, then put it all back together; yeah, it'll take most of a day."

"We sure need the crane," Evans said. "This one on the inbound track is used more than any of the others."

"Couldn't the pipe he electric welded without too much danger of fire?" Sparks asked.

"Yes,"—the water service man slowly nodded his head —"I don't believe there would be much danger. We could clean off around the break and have a water hose handy in case the oil caught fire. This stuff has to get pretty hot before it will burn."

"I'll send a man up to do the welding for you," Evans said. "How long will it be before you are ready?"

"We can have the crane straightened up ready for welding by the time the welder gets here," the water service man said.

"O. K.," Evans said, "I'll send the welder right up. Sparks, you find the portable crane operator—oh, hell, I forgot about the crane being out of commission. We'll just have to get enough men to manhandle the welder."

Evans didn't send a welder to repair the oil crane immediately. When the foreman reached the roundhouse he found all of the welding machines in use except the one in the electric shop.

"How long would it take to get that welder back together?" the foreman asked Sparks.

"Two or three hours," Sparks replied. "It's all finished except putting it together."

"Well," Evans looked at his watch, "it's almost your quitting time now. Go and get a bite to eat and come back and finish the welder. Is there a place to plug in a welder near the oil crane?"

"No," Sparks replied, "I'll have to run wires from the fuel oil pump house, but that's not much of a job. I've got some wire cable in the electric shop that can be used."

It was about nine o'clock when the welding machine was ready to go. "The next problem is getting enough help to drag the machine over the soft ground between here and the oil pump house," the welder said. "We sure could use the portable crane. Say, why can't we run the crane with the welder and let the crane pull it?"

"Might work," Sparks replied, "if we had some way of keeping the welder plugged in enroute. It would take a heck of a long cable to reach from here to the oil crane."

"Never thought of that," the man admitted. "Guess we might as well find a couple more men and start playing horse."

Next morning when Sparks, wearing a clean suit of overalls, stopped at the office to get his work card, the foreman was waiting. "Say, you didn't connect the switch on the oil crane after it was repaired last night," Evans said.

"No," Sparks replied, "I didn't know you wanted it connected last night. It's a fairly big job in the daytime and would have been worse in the dark. The conduit was bent up quite a bit, besides being broken at one place."

"Well, you'd better get on it right away," Evans said.

Sparks looked down at his clean overalls and groaned. They wouldn't be clean long after he started work on the oil crane. His wife had informed him very emphatically that morning that there would be no more clean overalls until next week.

About ten o'clock Evans had everything going in the roundhouse as smoothly as could be expected and went to the office to rest a few minutes and look over the last batch of mail that had come in. There was nothing alarming in the mail until he picked up a piece of yellow clip. There was a memo from the master mechanic saying that the superintendent of motive power would be in Plainville the next day and reminding Evans of the pile of metal on the scrap dock.

Evans frowned, then reached for the telephone. He called the shop where the gas engine for the portable crane was waiting to be repaired.

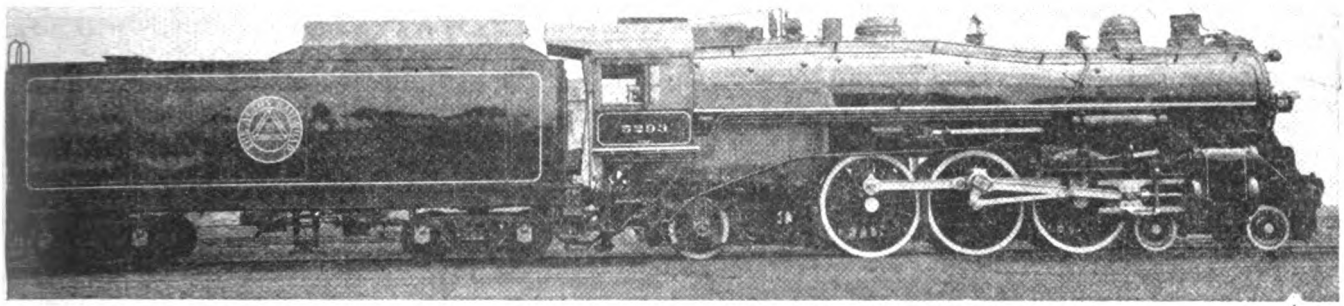
"How is the motor coming for our crane?" Evans asked.

"Still waiting for pistons," the repair shop man replied. "We've been expecting them every day for over a week. They should be here any time now and it won't take long to finish the job when we get the pistons."

"But I need the crane very badly," Evans said.

"Sorry, but I can't help it," the man said. "I've written, phoned, and wired, but it doesn't seem to do any good. If the pistons don't get here today, I'll wire again tomorrow."

(*Continued on page 18*)



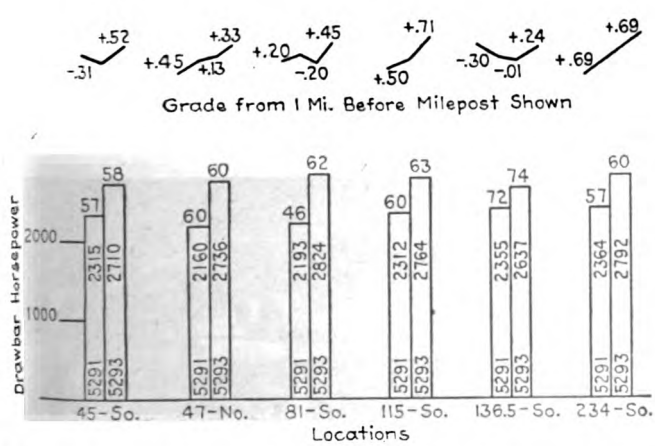
The power output was increased 27 per cent by modernization

Alton Locomotives Modernized

Several betterments applied on ten light Pacific-type locomotives permits hauling three more cars with less fuel

A PROGRAM of improvement to ten light Pacific-type steam locomotives, which the Alton has recently completed, enables this power to make a real contribution in the present emergency to passenger-train handling on this road. Tests indicate that, as a result of increasing the tender size and installing more efficient modern equipment and appliances on these locomotives, the drawbar horsepower has been increased 27.2 per cent and the unit fuel consumption decreased 23.6 per cent. The locomotives are regularly handling three more passenger cars per train than formerly and without any double heading on the fast schedule between Chicago and St. Louis, Mo.

Originally purchased from the American Locomotive Company in 1914, these locomotives were equipped with tenders having a capacity for 10,000 gal. of water and



Maximum drawbar horsepowers and speeds at which they were developed

14 tons of coal and used to haul seven heavy conventional passenger cars on an 8-hr. schedule for the 282-mile daily run between Chicago and St. Louis. In 1939, the need for longer runs between fuel and water stops became so pressing that the tenders were lengthened about 5 ft., increasing the capacity to 13,650 gal. of water and 19 tons of coal. The locomotives were also equipped with Standard stokers and Hulson Tuyere-type grates, the boiler pressure raised from 200 to 220 lb. and the main steam valves reduced from 15 to 12 in. It was found possible to enlarge the exhaust-nozzle tip from 6¼ to 6½ in. At that time, the consist of the Alton trains was increased to 11 cars and the running time shortened to 6½ hr. These trains, however, had to be double-headed over part of the road and in many instances over the entire district between Chicago and St. Louis.

The War Production Board, in freezing all orders for passenger power in 1941, upset the program of the Alton to supplement its supply of modern motive power and, with no new locomotives in sight and an urgent need for added power to handle more and heavier passenger trains, it was decided to see what could be accomplished by further improvement of the old steam locomotives. They were accordingly shopped and equipped with Worthington feedwater heaters, Nicholson Thermic syphons, Type HA superheaters and Dearborn automatic Foameters at an A-and-B cost of $6,635 per locomotive. At this time, the exhaust nozzle was also again increased ¼ in. in diameter, from 6½ to 6¾ in. As modernized, these 30-year old steam locomotives now handle 14 heavy conventional cars, an increase of three, with no double heading and a single locomotive running through between Chicago and St. Louis, daily, on a schedule of 5 hr. 50 min., with five intermediate stops in the 282-mile run.

The Pacific-type locomotives referred to in this article were originally called Class P-16 on the Alton, this designation being changed to Class P-16b for those which were improved in 1939 and Class P-16b (modernized) for those further improved in 1943 and 1944. In order to determine definitely what had been accomplished in connection with the latest improvement program, the management of the Alton arranged to make dynamometer car tests with a Class P-16b locomotive, No. 5291,

Principal Dimensions and Characteristics of the Alton Locomotives Tested

Data	Locomotives as purchased in 1913 Class P-16	Loco. 5291 as improved in 1939 Class P-16b	Loco. 5293 Modernized in 1944 Class P-16b(M)
Type of locomotive	4-6-2	4-6-2	4-6-2
Type of stoker	None	St'd.	St'd.
Engine:			
Cylinders, diam. and stroke, in.	25 x 28	25 x 28	25 x 28
Valve gear type	Walschaert	Walschaert	Walschaert
Valves, diameter, in.	15	12	12
Valve travel, in.	6½	6½	6½
Boiler:			
Working pressure, lb. per sq. in.	200	220	220
Grate area, type and sq. ft.	Table, 70.4	Hulson-Tuyere, 65.4	Hulson-Tuyere, 70.4
Feedwater heater or injector	Injector	Injector	Feedwater heater
Superheater units	Type A	Type A	Type HA
Driving-wheel diameter, in.	77	77	77
Tractive force, lb.	....	42,500	42,500
Heating surfaces, sq. ft.:			
Firebox	240	240	240
Arch tubes, number and sq. ft.	None	4-32	2-16
Syphons, number and sq. ft.	None	None	2-65
Total evaporating surface	3,967	3,999	4,048
Wheel bases, ft.-in.:			
Engine and tender	70-11	75-10	75-10
Weights in working order, lb.:			
On driving wheels	172,417	179,610	179,610
Total engine	277,350	282,150	282,150
Tender			
Axle size, in.	....	6½x12	6½x12
Wheel diameter, in.	....	36	36
Total weight, loaded, lb.	....	249,600	249,600
Loaded weight, front trucks, lb.	....	126,800	126,800
Loaded weight, rear trucks, lb.	....	122,800	122,000
Wheel load per inch of wheel diameter, lb.:			
Front trucks	....	440	440
Rear trucks	....	426	426
Water capacity, gals.	10,000	13,650	13,650
Coal capacity, lb.	28,000	38,240	38,240
Miscellaneous:			
Exhaust nozzle tip, dia., in.	6¼	6½	6¾
Foam meter	No	No	Yes
Theoretical potential cylinder horsepower	2,330	2,390	2,830

against a locomotive of the same class, No. 5293, after it had been fully modernized. These dynamometer car tests, completed on April 9, 1944, comprised 9 test runs made on Alton Limited trains No. 1 and No. 4 of the Alton between Chicago and St. Louis. Data secured on the individual test runs are given in one of the tables. Run 6 was from Chicago to Bloomington, Ill., only.

Results of the test runs are summarized in another table which shows that Locomotive 5293 handled more cars, faster and with less fuel and water after being modernized. For example, the number of pounds of coal per car-mile decreased almost 20 per cent; water evaporation per lb. of coal increased about 11 per cent; drawbar pull increased practically 17 per cent and drawbar horsepower 27.2 per cent; boiler efficiency increased from 52.28 to 60.38 per cent; overall efficiency increased from 3.53 to 4.79; maximum power developed increased from 2,364 to 2,824 hp.

The overall efficiency of Locomotive 5293, 4.79 per cent, is not high even for a modernized steam locomotive, doubtless due to the abnormally heavy trains handled during the test. The test report calls attention to the influence of excessive loads in decreasing locomotive efficiency and states that, with lighter trains, Locomotive 5293 may be expected to show efficiencies up to 6 per cent. The horsepower figures represent the theoretical cylinder horsepower and the tests show that Locomotive 5293 is capable of producing as much horsepower at the drawbar as it formerly developed in the cylinders.

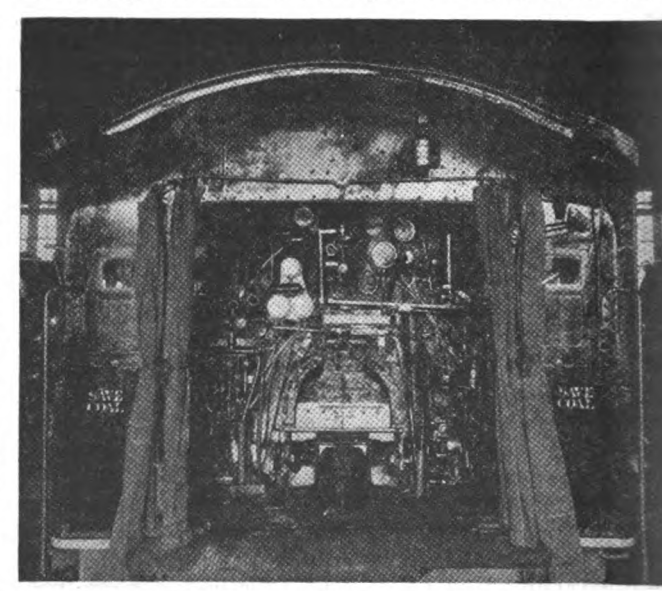
While modernized Class P-16b locomotives are daily hauling 14 cars in the present emergency, 13 cars was the maximum number used on any of the test runs and the dynamometer-car tests demonstrated that Locomotive 5293 is readily capable of handling trains of this size. While the heavy loading of a relatively small steam locomotive may necessitate some sacrifice in fuel economy, if such a train were doubleheaded there would be a much greater fuel consumption by reason of using two locomotives, to say nothing of the increased cost of maintenance for the additional locomotive as well as the wages of the additional crew.

Seven Tons per Trip Fuel Saving

With respect to the coal consumed, it is indicated from the tests that, where Locomotive 5291 would consume an average of 27 tons of coal under present conditions, modernized Locomotive 5293 would handle the same train under identical conditions requiring only 20 tons of coal, or a saving of 7 tons per trip. All coal used was carefully weighed and samples analyzed, considerable variation being found. For example, ash content varied from 14 per cent down to 5 per cent; moisture from 12 to 7 per cent; and B.t.u. per lb. from 12,300 to 10,000.

It is believed that the performance of Locomotive 5293 with the dynamometer car demonstrated conclusively that with 10 or 11 cars under normal operating conditions, it will be possible to eliminate one coal stop which, in turn, will produce additional fuel economy. The tests showed that Locomotive 5293 can be worked when necessary with a substantially longer cut-off than Locomotive 5291 and still maintain full steam pressure and, of course, develop increased power output. An analysis of the four highest drawbar horsepower ratings for each of the southbound and northbound runs for each locomotive shows an overall average maximum drawbar horsepower of 2,739 for Locomotive 5293 and 2,232 average maximum drawbar horsepower for Locomotive 5291, or an increase of 507 drawbar horsepower.

The modernization of the P-16b class locomotives has resulted in this power being able to maintain an on-time performance when handling an increase of three standard weight cars per train on trains No. 1 and 4 over and above what they were handling prior to modernization. This increased capacity has made it possible to handle the heavier train load due to increased passenger travel during the war emergency, and it may be said, that, by increasing the drawbar horsepower of each modernized



Back boiler head of modernized Alton Locomotive No. 5293

locomotive, the railroad has acquired the equivalent of 5,070 additional horsepower or approximately two additional locomotives. However, in normal times when only 10 or 11 cars are being handled, it is reasonable to expect an average saving of 6 to 8 tons of coal per trip between Chicago and St. Louis.

The modernization of the ten P-16b class locomotives has resulted in a fuel saving approximating $100,000 annually, and has also resulted in a material reduction in the number of double-header locomotives formerly used.

In conducting these dynamometer car tests on the Alton, the following general procedure was adopted:

The test crew consisted of three men in the dynamometer car—one operator, one location spotter and one general data man. The test crew on the locomotive included one cab data observer, one coal weigher, one locomotive supervisor, one assistant supervisor and two coal passers.

All instruments used were calibrated before the test and re-checked throughout the tests to insure continued accuracy. It was necessary to eliminate test data involving drawbar-pull calculations on Test 9 on account of the dynamometer going out of adjustment.

Figures for calculation of the average drawbar pull, average horsepower and etc., were obtained by planimetering the drawbar graph from the chronograph chart. Maximum drawbar horsepowers were determined by comparing both locomotive performance at selected locations, the same locations being used for all tests.

All coal was weighed on the locomotive as used, with a special beam scale having a capacity of 400 lb. of coal. To insure accuracy the scale was calibrated before and during the tests. Coal weight figures were recorded in triplicate, by the coal weigher, cab data man and by electrical contact on the scale which recorded each bucket on the dynamometer-car chronograph chart.

The tender tank was calibrated by filling the tank with water and determining the volumetric capacity per inch in depth by running the water out of the tank into 55 gal. barrels. This was further checked by weighing the tender tank empty and full of water and checking the weight of the water against the volumetric determination corrected for temperature. The opposite corners of the tender tank were equipped with hoses and sticks marked in inches. All test water readings were taken simultaneously at opposite corners of the tender tank to insure accuracy. The temperature of the water in the tender tank was determined each time water was taken.

All pertinent data relative to locomotive operation and general conditions were recorded every five minutes by a man in the cab. Drawbar pull, speed and brake appli-

Test Data Secured on Individual Runs with the Dynamometer Car

Engine number	5291		5293		5291		5293		
Train number	4		4		1		1		
Test number	1	3	5	7	2	4	6*	8	9
Date	3-28-44	3-31-44	4-4-44	4-7-44	3-29-44	4-2-44	4-5-44	4-8-44	4-9-44
Number of cars	13	11	12	12	12	12	13	13	13
Lt. wt. of train, tons	1,017.51	842.89	942.59	937.36	937.36	913.13	998.64	1,019.11	1,037.09
Elasped time, hrs.-min.	6-54.8	5.53.5	6-21.8	5-49.0	7-44.0	5-49.0	2-18.8	5-53.0	5-45.5
Running time, hrs.-min.	6-07.6	5-13.7	5-36.4	5-12.0	6-28.2	5-19.9	2-17.2	5-29.9	5-24.9
Delays, min.	47.2	39.8	45.4	37.0	36.2	29.1	1.6	23.1	20.6
Ave. speed, elasped time	40.69	47.73	44.19	48.37	39.72	48.34	55.18	48.03	49.02
Ave. speed, running time	45.88	53.75	50.16	53.83	43.46	52.74	55.53	51.47	52.16
Distance, miles	281.3	281.3	281.3	281.3	282.3	282.3	126.6	282.3	282.3
Number of car miles	3,656.9	3,094.3	3,375.6	3,375.6	3,387.6	3,387.6	1,648.4	3,669.9	3,669.9
Ave. boiler pressure, lb.	206	214	210	213	196	211	213	213	216
Min. boiler pressure, lb.	175	195	170	170	170	187	195	190	203
Ave. steam-chest pressure, lb.	185	196	191	192	176	193	187	186	178
Max. steam-chest pressure, lb.	200	205	210	200	200	205	195	215	205
Ave. back pressure, lb.	10.3	10.3	9.9	12.1	11.1	10.7	12.4	11.6	9.3
Max. back pressure, lb.	19	17	21	17	20	19	20	17	16
Average cut-off, per cent	40	32	46	47.4	40.3	32	52	51.1	48
Minimum cut-off, per cent	25	22	30	30	25	24	40	35	25
Ave. steam temp., deg. F.	596	601	639	648	573	600	643	630	638
Max. steam temp., deg. F.	605	605	680	680	605	610	660	680	700
Coal									
Total coal, lb.	62,027	39,350	47,450	42,350	58,909	44,100	19,500	42,250	38,100
Coal standing, lb.	1,600	500	800	800	400	1,150	none	600	700
Coal running, lb.	60,427	38,850	46,650	41,550	58,509	42,950	19,500	41,650	37,400
Coal lost at pops, lb.	22	16	53	23	11	9	34	142	34
Coal lost at blowoff, lb.	557	573	632	250	540	516	none	113	335
Net coal running, lb.	59,848	38,261	45,965	41,227	57,954	42,425	19,466	41,395	37,931
Coal per car-mile, lb.	16.96	12.72	14.06	12.54	17.38	13.02	11.82	11.51	10.38
B.t.u. per car-mile	175.9	147.8	152.3	140.1	201.4	146.8	135.6	133.3	114.9
Coal per db. hp. hr., lb.	7.55	4.73	4.76	5.15	6.77	6.03	4.65	4.61	6.48
B.t.u. per db. hp. hr.	78.30	65.45	51.55	57.50	78.50	68.07	48.70	53.40	71.90
Coal per hour, lb.	9,861	7,360	8,318	7,991	9,042	8,060	8,430	7,573	6,912
Coal sq. ft. grate per hr., lb.	150.8	113.6	118.2	113.4	138.3	123.2	119.7	107.6	98.2
B.t.u. total coal	643,482	457,195	514,121	472,762	682,548	497,429	229,008	489,174	421,801
B.t.u. net coal running	620,638	444,397	497,860	460,659	671,541	478,656	228,609	479,397	410,189
Ave. b.t.u. coal fired	10,372	11,614	10,831	11,125	11,579	11,256	11,744	11,579	11,077
Water									
Tot. water out of tender, gals.	30,589	25,760	27,527	26,981	32,375	26,873	12,835	27,646	24,304
Manual blowoff, gals.	1,469	1,512	1,054	652	1,436	1,361	0	248	0
Automatic blowoff, gals.	0	0	614	7	0	0	0	50	873
Water loss at pops (Gl)	166	122	39	177	82	60	255	1,077	255
Total water evap., gals.	29,120	24,248	25,859	26,255	30,939	25,506	12,580	27,332	23,431
Total water evap., lb.	242,570	201,986	215,405	218,704	257,722	212,465	104,791	227,676	195,180
Water evap. per lb. coal, lb.	4.05	5.28	4.68	5.30	4.45	5.01	5.37	5.48	5.27
Water evap. lb. coal 10,500 b.t.u.	4.10	4.77	4.54	4.98	4.03	4.66	4.92	4.97	4.99
Factor of evaporation	1.282	1.283	1.285	1.286	1.277	1.283	1.287	1.285	1.284
Boiler evap. from/at 212 deg. F.	5.19	6.77	6.01	6.82	5.68	6.43	6.91	7.04	6.77
Steam to auxiliaries, lb.	27,227	19,805	22,314	13,106	26,671	22,135	8,915	21,666	14,122
Steam to cylinders, lb.	215,343	182,181	193,091	205,598	231,051	190,330	95,664	206,010	181,088
B.t.u. required for steam for auxiliaries	1,187.1	1,188.1	1,186.8	1,185.5	1,187.0	1,186.9	1,184.2	1,184.5	1,184.1
B.t.u. required for steam for cylinder	1,307.1	1,307.7	1,328.0	1,330.0	1,286.4	1,306.5	1,335.5	1,330.4	1,335.4
Locomotive Performance									
Ave. db. pull, lb.	10,565	9,058	12,854	10,721	11,423	9,377	11,908	11,893	7,593
Ave. db. hp.	1,293	1,298	1,720	1,539	1,522	1,319	1,763	1,632	1,056
Drawbar hours	7,926.1	6,788.5	9,649.2	8,002.8	8,553.3	7,030.3	4,019.6	8,976.0	5,713.0
Steam per db. hp.-hr., lb.	27.18	20.84	20.02	25.68	27.03	27.07	23.80	22.62	31.71
Boiler efficiency, per cent	48.39	57.26	56.10	61.13	48.19	55.28	61.75	61.29	61.39
Overall efficiency, per cent	3.25	3.89	4.94	4.43	3.24	3.73	5.03	4.77	3.54

* Chicago to Bloomington, Ill., only.

General Summary of the Test Results

Item	(A) No. 5291	(B) No. 5293	Ratio Col. B to Col. A minus 100 per cent
Number of cars	12	12.6	5.00
Lightweight of train, tons	927.71	987.35	6.44
Running time, hr.-min.	5-47.35	5-21.8	-7.93
Average speed running time, m.p.h.	48.88	52.21	3.75
Average boiler pressure, lb.	207	213	2.90
Average steam-chest pressure, lb.	187.5	187	-.27
Average exhaust steam pressure, lb.	10.6	11.1	4.80
Average cut-off, per cent	36.1	48.9	35.50
Average steam temperature, deg. F.	592	640	8.10
Average superheat temperature, deg. F.	202	248	22.77
Coal per car-mile, lb.	15.01	12.06	-19.65
Thousand B.t.u. per car-mile	168.0	135.2	-24.30
Coal per drawbar horsepower-hour, lb.	6.27	4.79	-23.60
Thousand B.t.u. per drawbar hp.-hr.	72.58	52.82	-27.20
Coal per sq. ft. grate area per hr., lb.	131.5	111.4	-15.30
Total water evaporated, gals.	27,453	25,719	-6.33
Water per lb. coal, as fired, lb.	4.70	5.22	11.05
Water per lb. of coal (10,500 B.t.u.), lb.	4.39	4.88	11.18
Factor of evaporation	1.282	1.286	.31
Equivalent evaporation	6.02	6.71	11.45
Average drawbar pull, lb.	10,106	11,844	17.15
Average drawbar horsepower	1,308	1,663	27.20
Drawbar horsepower-hours	7,574.5	8,876	17.20
Steam per drawbar hp.-hr., lb.	27.03	23.03	-14.80
Boiler efficiency, per cent	52.28	60.38	15.49
Overall efficiency, per cent	3.53	4.79	35.75
Maximum hp. (mile post 234 southbound)	2364		
Maximum hp. (mile post 81 southbound)		2824	

cations were recorded continuously by automatic pens on the chronograph chart. Locations and other notes including time past stations, mile posts and etc., were recorded on the chart manually.

A general log of all trips was kept covering weather and track conditions and any unusual operating conditions observed. Atmospheric temperature was recorded at four locations on each trip, using a thermometer located outside the test car. Wind conditions were secured from local government weather stations at Chicago, Springfield and St. Louis for the times the train was in that location, but the effects of wind and temperature were not calculated for these tests.

During the tests, an analysis was made of the coal taken each time and there was considerable variation. For example, there were occasions when stored coal was obtained from the terminal at St. Louis and it ran as high as 14 per cent in ash and other coals as low as 5 per cent ash. The moisture content varied from about 12 per cent to 7.5 per cent. At Chicago, the Wilmington coal in some instances ran as high as 12,300 B.t.u., whereas the Ridgely coal was just under 10,000 B.t.u. Fuel consumption was calculated on B.t.u. per drawbar horsepower-hour, because the quality of coal taken throughout the tests varied so greatly.

In calculating the steam consumed by auxiliaries, it was assumed that the air compressors use 25 lb. per min.; headlight generator, 100 lb. per hr.; steam heat, 100 to 200 lb. per hr. per car, dependent upon outside temperature; stoker engine, 1 to 1½ per cent and stoker jets 1 to 2 per cent of boiler output, dependent upon the type of stoker; safety valve, 1,100 lb. per min.

A Scrappy Job

(*Continued from page 14*)

Evans cradled the receiver and walked out to the scrap dock. The more he looked the worse he felt. There was a car spotted and waiting, but one car wouldn't hold the mountain of scrap, it would take two.

He found his available labor force—two house cleaners, one pit cleaner, and the man that cleaned the machine shop—and told them to go to the scrap dock and start loading scrap. It didn't take long to see that the four men wouldn't be able to make even a decent showing by the time the S. M. P. arrived.

Evans thought of calling out the whole force, mechanics, helpers, and all, to load scrap, but that would mean delays to locomotives and after all getting the locomotives out was more important than loading scrap, and he wasn't minimizing the importance of scrap either.

The foreman knew the superintendent of motive power would be hot as a firecracker but there was little that could be done without the crane. In one day two men with the crane would load more scrap than a dozen men could load by hand.

THE job at the fuel oil crane hadn't been quite as messy as Sparks had feared. The water service men had cleaned a good bit of the oil off the crane and Sparks wiped off more. He managed to get the job finished with a few clean spots left on his overalls but his gloves were ready for the trash can. He gathered up his tools and went back to the electric shop. While Evans was stewing around the scrap dock, Sparks, passing by, saw that the foreman was in a sweat and he had a good idea why.

The electrician wiped his tools and laid them on the work bench, then got a piece of waste and some carbon tetrachloride, a very scarce article, and began trying to clean some of the oil from his overalls.

While Sparks was making the more or less successful attempt at dry cleaning, Evans came into the electric shop. The electrician expected Evans to say something about carbon tet being too scarce for such use, but the foreman had other things on his mind.

"Did you finish the oil crane?" Evans asked.

"Yes, it's O. K.," Sparks replied. "Did you want something else done?"

"Nothing special," Evans replied, "unless you can find a motor for the portable crane. That scrap almost has to be loaded before tomorrow noon."

"Afraid I wouldn't know where to get a motor," Sparks said, then when Evans started to leave Sparks had an idea. "Say, I might be able to get the crane going after a fashion."

The foreman turned suddenly. "How?"

"Well, we could hook up an electric welder out by the scrap dock and run the crane with current from the welder. Some one would have to regulate the welder while the crane operator handled the crane controls."

"It's worth trying," Evans said hopefully. "Let's see if it will work."

The crane was pushed out to the scrap dock, but the six men could not start it up the incline.

"Wait, and I'll connect the welder to the crane motor," Sparks said.

Operation was slightly awkward at first. Sparks operated the welder controls to regulate the voltage while the portable crane operator handled his machine. After two unsuccessful attempts the crane pulled itself up the incline to the scrap dock and loading began. In an hour the operators had learned how to work together better and the work went along almost as well as though the crane had its usual power. A laborer on the dock fastened the chain to the scrap and another in the car unhooked and threw the chain back. Another car was set that night and the last scrap loaded before noon.

Evans, very well pleased, looked at the empty dock and went to the office. Two minutes later the phone rang. It was the man in the repair shop uptown. "We got the pistons and the motor will be ready this afternoon," the man said.

He still wonders why Evans swore.

A Journal Bearing that Reduces

Waste Grabs and Hot Boxes

By B. R. Jones*
and
P. J. Hogan†

It is well known that there have been no great changes in the type or style of friction journal bearings for railroad cars and locomotive tenders in the past 80 years, except where slight changes have been made in dimensions to accommodate larger loads and faster train schedules, and in the addition of a soft metal lining. These changes have not solved the problem of preventing waste grabs and, in spite of every precaution, we still have them. For purposes of review, the following is a partial list of some of the causes of hot boxes: waste grab; rolling waste; packing not in contact with the journal; too much packing; packing caked or glazed; boxes improperly packed; insufficient packing; time between periodic packing dates too long; boxes packed too tight; loss of oil through use or leakage; packing too dry; poor quality of packing; wiping on edge of bearing caused by lining spread; wiping by trapped waste in lining grooves; wiping by waste jam at bearing top in box; wiping caused by waste ledge projection in box; improperly saturated waste; improper oils; abrasive matter in packing; defective or broken bearing; improper application of bearing lining to shell; shelled out lining; cracked lining; concentrated pressure due to uneven bearing; wrong bearing size for journal; lining worn out; overload on bearing; improperly finished bearing surface; excessive journal taper; improperly finished journal; truck out of square; bolster guides and columns worn; water or ice in box; top of wedge not having proper bearing in box; distorted or broken wedge; broken journal box; crown of box worn hollow; careless workmanship in assembling trucks; careless handling of journals and lack of protectives; flat, rough and badly worn wheels and wheels out of round; rough track surfaces; rough handling in switching; rough handling in road-haul trains; excessive journal-bearing tilt; excessive journal-bearing roll between box stops; improperly maintained machinery in manufacturing and finishing of axles and bearings; worn or broken dust guards.

Waste Grabs

It has been estimated that at least 70 per cent of all hot boxes result from waste grabs. The large percentage of failures directly chargeable to these grabs led our mechanical department into a campaign to find out just what caused waste grabs and to try to correct the condition before the hot box developed. No practical answer had been obtained up to 1935 to stop waste grabs during ordinary handling of cars.

A careful study of photographs made of action in journal boxes during switching shows the necessity of stopping waste grabs by preventing waste from coming in contact with the journal in the "danger zone," that is at the lower edge of the journal-bearing lining metal and the journal proper. A study shows that there is sometimes a three-way movement of journal bearings relative to a fixed center line of the axle. These movements may be upward which causes a lifting of the bearing off the journal; or, there may be a tilting action; or, a forward or backward movement of the bearing relative to the fixed ends of the car.

In any case it is easily seen that when, for any reason, the bearing is moved from its normal position an aperture is opened which can trap any loose ends of waste that may be near its lower edges. As this opening becomes larger it tends to grab the waste which is then carried between the bearing lining and the journal.

It is a well-known fact that when a new bearing is placed on a journal the surface of the bearing that at first actually carries the load is limited to a fraction of the total bearing surface. This area is usually about one inch wide in the center and extends the entire length of the bearing. This means that there is a larger opening present at this time between the lower edge of the lining metal and the journal surface than exists after the bearing wears in and settles on the journal. This condition is, of course, more pronounced after a journal has been reconditioned because of the smaller turned diameter of the journal.

Attacking the Problem

It was felt that any device used to overcome this grabbing tendency should be simple, have no moving or re-

Example of a waste grab developed after the bearing had raised from the journal at yard-switching impact speed

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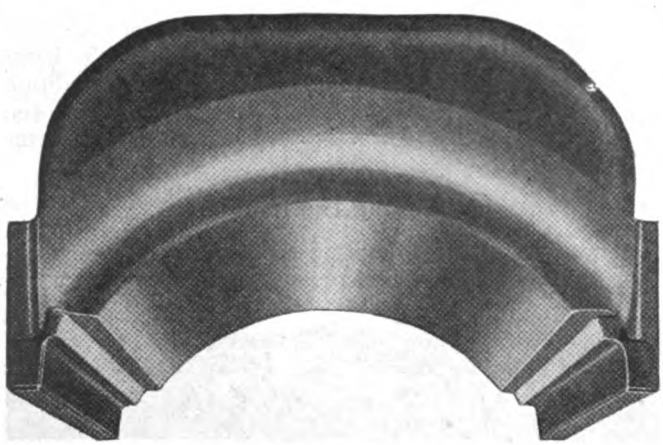
movable parts, should be a part of the brass itself, should not be too expensive, and should not require any additional labor for inspection or maintenance.

Wipers intended to remove foreign matter that might cling to the revolving journal were investigated. They not only removed the foreign matter, but wiped the oil off the journal surface and caused a failure on the first trial during switching operations in the make-up of the train at the terminal. This test demonstrated to us that it would not be a good thing to have anything rub directly on the journal bacause of the danger of removing the necessary lubrication from the journal as well as the danger of having a wiper deface the smooth surface of the journal itself.

Photographs show that, with a standard A. A. R. brass, when the waste starts to roll on the rising side, it goes up against the lower underside edge of the brass and remains in the "danger zone" where lint, loose ends, and sections of waste can be grabbed and pulled under the lining of the brass and on to the journal proper. We felt it necessary, therefore, to find some means to move this rolling waste away from the journal and toward the side of the box to eliminate the possible danger of grabbing.

A journal bearing was designed which had two integral extensions, one on each side of the brass, extending its full length. These extensions were located so as to allow about 1/8-in. clearance at all times between the journal and brass and to project about 1/2-in. below



Bearing design employed on the New Haven which is responsible for reduction of waste grabs and resulting hot journals

the under side of the brass. These projections added considerably to the structural strength of the brass, prevented rocking and definitely stopped waste grabs in regular switching and road operation. With the build up of train speeds, the eddy current of air created between the journal and the integral extension ledges along the sides of the bearing diverts lint to the box side. This accumulation is in evidence on high-speed trains. Further, the extended deep sides prevented rocking and guided the bearing to its natural position on the journal.

Proving that these brasses would stop waste grabs under all operating conditions was our next step. In 1935, eight new 5-in. by 9-in. modified A. A. R. brasses were made incorporating the two integrally-cast waste-repelling ledges. These brasses were placed in test service on a dining car. Journal boxes were packed to the full center line of the journal to aggravate the tendency to waste grab. A nine months' test period followed and no report of any waste grab was received. These added waste deflecting projections actually repelled the rolling waste away from the journal toward the sides of the box.

After the original test, approval was given for further applications to other cars. About March, 1937, 48 special brasses were applied to four more dining cars. About June, 1937, 200 special brasses were applied to fifteen streamline passenger cars and to four standard passenger cars and one dining car, all with 5-in. by 9-in. journals. In June, 1938, 400 special bearings were applied to 50 new streamline passenger cars. Up to about September, 1942, these fifty cars ran over 150,000,000 box miles without a single failure due to waste grab or hot box. An additional 50,000,000 box miles were added up to September, 1943, without any sort of failure.

An outside laboratory test was made in 1938 to check our findings that this bearing would stop waste grabs. Arrangements were made with the Magnus Metal Corporation to run a series of tests on their special testing machine. The findings were, "These test runs did not result in a waste grab and the special design of the bearing with its extending ledges did turn the waste away from the journal when the waste was moved to contact with the ledge."

In 1940, 50 new caboose cars were built on which standard A. A. R. bearings were applied. After a short time, these bearings were running hot, and waste grabs were developing because the cars were used on a section of road where pusher engines were employed. These brasses were removed and replaced with the special brasses. No further trouble was reported. Seventy-five more new caboose cars of the same design have been purchased since with these special brasses, and all of them are still operating without a hot box from any cause.

We were having considerable hot-box trouble on locomotive tenders. Tender hot boxes are seldom heard of now since we have applied the special brasses.

In June, 1939, it was reported that there had been no trouble of any kind from the 648 special brasses then in service. Tests continued until May 1, 1942, with no running hot or any demonstrable failure chargeable to these bearings.

These bearings were adopted May, 1940, as standard on passenger cars and locomotive tenders having A. A. R. standard axles. This action was taken because it seemed definitely proved that this bearing had greater durability, gave better lubrication and prevented waste grabs.

In January, 1940, 2,000 additional special bearings were applied to 250 self-clearing twin hopper cars which have a capacity of 120,000 lbs. each. A very careful performance record has been kept on all these cars and in two 15-month repack periods not one hot box has been reported due to waste grab.

In May, 1941, 8,000 of these bearings were applied to 1,000 new 60-ton box cars. No exact record was kept of the large mileage covered by these cars which gave trouble-free operation with no hot boxes reported due to waste grabs for two 15-month periods. None of these hopper or box cars have appeared on a train or car performance sheet with a hot box since they were built.

Some of these bearings have been removed when wheels were changed but they are few in number. Emergency brasses have replaced the special bearings found defective at the time for periodic repacking.

A policy has been adopted of not relining any passenger- or freight-car brasses. Experience has shown that many times a hidden flaw will exist in a brass and may be the cause of an early brass failure when it is put under the stress of operation. The added cost of new bearings over relined ones has been well-justified by an exceptionally good record.

EDITORIALS

Electrical Potentials

The hand-to-mouth kind of procedure which has characterized all railroad operations for several years must be continued at least for the duration of the European phase of the war. It means a continuation of material conservation, the doing of more with less manpower, and in many cases the making of installations which must be replaced when circumstances permit. Codes have been relaxed, but in most cases it may be expected that they will again be reestablished in much of their original form. Some of the substitutes permitted will be accepted as being superior to older materials but this will not have much bearing on the replacement of installations. The situation is creating a lot of deferred work, but the volume represented is small in comparison with new work based on the adoption of many engineering developments awaiting release.

One requirement which can not wait is adequate electrical maintenance facilities for Diesel-electric locomotives. Although this type of motive power has been in railroad service for 20 years, it was not until 1940 that any considerable amount of road power was used, and it is the locomotives hauling heavy high-speed trains which require heavy-duty service of traction motors.

In the car lighting and air conditioning field there is an extremely difficult maintenance situation which must look to the future for its final resolution. Cars have been overworked so intensively and for so long that much new and rebuilt equipment is required. This situation will be intensified by the railroads' need for the best in passenger cars to meet postwar competition. Material has already been released for the building of 40 aluminum and 15 steel passenger cars and it is estimated that it will be necessary to build from 2,000 to 3,000 cars per year for a period of five years.

Train communication offers real improvement of train operation and fulfills immediate needs so well that orders have been placed for installations covering 1,039 miles of line and costing nearly $2,000,000. As its use is extended, a need for caboose power supply will develop. On the locomotive a larger turbo-generator or two such units may be used. At present only straight storage battery systems are planned for cabooses. These can be kept charged by terminal charging stations, but the history of car lighting suggests that eventually either axle-driven or engine-driven generators will be used to supply the necessary power.

Many enormously large and expensive lighting installations have been made in war manufacturing plants, but either the railroads have not been considered war plants, or their reputation for getting along with relatively little light is so good, that very little thought has been given to the making of improvements. In the face of constant, and, on the railroads, high depreciation of lighting fixtures and wiring, this should become a fruitful field for making beneficial improvements.

As usual, plans are being made for installations of electric traction. Actual installations require long study and large capital expenditure and are made only at long intervals. It is, however, heavy traffic density which makes the use of electric locomotives profitable, and in certain locations present traffic is extending existing steam power beyond the limits of designed capacities.

These and many other potentialities of electrical equipment are being brought nearer to realization by new devices and materials, some of which have grown out of war needs. Among these are new insulating materials which reduce size and weight of apparatus and permit higher operating temperatures, recently developed communication equipment, some of which is still awaiting military release, greatly improved public address systems, completely new types of light sources, a wide assortment of plastics, improved generating equipment, air compressors, air-conditioning control and lighting systems for passenger cars, better wiring materials, better and lower-cost capacitors, electronically controlled variable-speed motors, welding control that insures good welding, hot-journal indicators and many other protective devices. These developments and many others, a considerable part of which have been stimulated by the pressure of war, will make the postwar period interesting for those with imagination, and if effectively used will do much to retain the position and importance of the railroads in the field of transportation.

Mechanical Division Research During 1944

If one is inclined to forget that the Mechanical Division of the Association of American Railroads has been engaged extensively in the conduct of engineering research projects for the past six or seven years, a glance at the library shelf holding the research reports which have been forthcoming during this period will be a sufficient reminder. During this time extensive investigations have been conducted on freight-car trucks, on the horsepower requirements for heavy high-speed passen-

ger service, on passenger-car axles, on locomotive crank pins, and on counterbalancing locomotives for high-speed service. Some of these projects have been the subjects of several progress reports.

Reports on two projects have appeared during 1944. These are the Second Progress Report on Locomotive Crank Pin Tests and the report on the counterbalance tests. The first represents a matter which falls entirely within the bailiwick of the Mechanical Division. The latter covers a subject of interest alike to the Mechanical and Engineering Divisions and they participated jointly in the conduct of the study.

Engineering investigations are nothing new to the Mechanical Division. They have been under way almost from the beginning of the organization of the Master Car Builders' and the American Railway Master Mechanics' Associations. There has, however, been some change in the character of these investigations. A number of those which have been under way during the past six or seven years are distinguished from many of the earlier studies in that they are seeking basic engineering data affecting the strength and performance of details, whereas more, but by no means all, of the earlier projects were much less specific in the character of the data they brought together.

Of the two reports which came out in 1944 that on the crank pins is a progress report and does not represent the final results of the project. Its conclusions, however, are sufficiently definite within the scope of the second year's work to be of immediate value and, undoubtedly, many railways have already taken advantage of the information presented therein to improve their practice with respect to crank-pin fits. The conclusions of the counterbalance tests have effectively set the limits within which the overbalance compromise is satisfactory, both from the standpoint of the operation of the locomotive and the track. They should also settle the controversy over the value of refinements in rotating balance which has been carried on for a good many years.

Broad Appraisal Of Motive Power Needed

As we go into the year 1945 the railroads find themselves in one of the most favorable positions with respect to motive power in their entire history. The justification for the statement lies in the fact that the roads have many types of power to choose from; new types in prospect and a wealth of operating experience as a guide in formulating policies for the future.

Prior to the outbreak of the war, a satisfactory condition as to motive power needs was one in which there existed a reasonably safe margin of serviceable locomotives to be drawn upon for unforeseen emergencies. What that safe margin was is indicated by the records of stored and shopped locomotives in relation to the ownership. The sudden increase in demand created by wartime traffic left railroad operators without safe margins for they not only had to use up practically all of the reserve, but were not able to get new power to supplement their needs. Many railroads had partially fortified themselves against the emergency by purchases, of modern high-capacity steam units and the adoption of the Diesel-electric locomotive.

The Diesel-electric has brought home the value of intensive utilization of power and provided competition that has acted as a challenge to steam. Its outstanding performance has developed within railroad organizations both the necessity and the desire to find out whether steam power could not also approach these same performances.

The operating department forms its judgment of motive power from such factors as availability and failure-free performance. It is not concerned with matters of design nor does it care how or where the mechanical department gets the locomotives just so long as they are there when needed and do the job they are called upon to perform. An appreciation of this fact will help to understand why the Diesel has been so popular with the operating man and why it has been called the "answer to an operating man's prayer." It has served to set a pace for other types of power that has brought out hidden values and possibilities not heretofore realized and the impetus of this pace-setting is largely responsible for the operating performances that place the railroads in a position of confidence born of accomplishment.

This war will not last forever. When it ends the railroads will again be faced with the problem of conducting business in a world of intense competition in the field of transportation and where success or failure will depend entirely upon the ability to meet that competition on a profitable basis.

Possibly there never has been a time in railroad history when management was so greatly in need of a coldly practical appraisal of the entire motive power question. Management today must look to someone for the answers to questions relating to the economics of the motive power problem. Management is also faced with the necessity of apportioning expenditures for improvements between motive power, rolling stock, roadway improvements, shop and terminal improvements and a variety of other opportunities for worth-while investment.

The largest items in the entire category of railroad expenditures are locomotive repairs and locomotive fuel. The proponents of Diesel power not only claim that it will save the railroads millions of dollars in these two expense items alone but that it is an operating facility with none of the disadvantages of steam power. Those who back the steam locomotive claim that, if given the same chance, it will do just as good a job as the Diesel and do it cheaper.

Here are two sides of a controversy in which railroad management stands as the referee. The mechanical of-

ficer must recognize that it is no longer a question of how many locomotives to buy; or what kind. What management wants to know is whether to buy locomotives (of whatever type); spend money for roadway, or repair facilities, or signals—and why.

Those who are promoting the interests of the Diesel have done an excellent job in selling to railroad management not a locomotive but an operating facility having potentialities that contribute to efficient and economical transportation. The steam locomotive has never been *sold* to anyone—it has been bought by the mechanical department not as an operating facility but as one of the tools of the trade. If the steam locomotive has operating potentialities which are not sufficiently recognized; if it has not been given the job that it is capable of doing, then those who promote the interests of the steam locomotive must recognize that it is management—the referee—that must be sold on the value of modern steam power.

The railroads are entitled to have all the facts in a case of this kind. If the Diesel is better than steam, or vice versa, let's find out why. But let's not be prejudiced by the conclusions until we have made sure that it is the interests of the railroads that we have in mind.

NEW BOOKS

LOCOMOTIVE ENCYCLOPEDIA—1944 EDITION. *Published by the Simmons-Boardman Publishing Corporation, 30 Church street, New York 7. 1,396 pages, 8¼ in. by 11½ in., illustrated. Bound in Fabrikoid. Price, $5.*

The 1944 Locomotive Cyclopedia is the twelfth edition of this reference book, the first of which was printed in 1906. In general, this new edition follows the form of the 1941 book and is divided into 20 sections, each of which covers a group of associated equipment and thus simplifies reference to any particular group. The use of the book is also made easy by the five tabulated indices. There are also several bibliographies covering articles in recent publications. While the general make-up of previous editions has been retained, the subject matter has been thoroughly revised. A large amount of new material has been incorporated and only such old material retained as still represents regular current practices and which is needed to make the book complete. In the work of revision the editors have received valuable assistance from the Advisory Committee appointed by the Mechanical Division of the Association of American Railroads; the mechanical heads of practically all railroads; the locomotive builders; the manufacturers of locomotive equipment, and those supplying machine tools and shop equipment. The book contains 1,396 pages, 84 more than the previous edition and the largest number in any edition yet published. In the sections devoted to steam-locomotive equipment there are elevation drawings of a number of steam locomotives of recent design; improved lubrication equipment; new types of locomotive tenders of large capacity, and new and improved brake equipment. The section covering Diesel locomotives for railroad service has been greatly extended to cover current developments in this type of locomotive for switching, transfer and road service, both freight and passenger. Information in regard to railroad electrifications has been fully revised and brought up to date. The section on Export locomotives has been amplified to include locomotives of all types instead of only steam locomotives. New material has also been added for Industrial Locomotives. Descriptions of locomotive specialties and devices are much more complete than in any previous edition. The section devoted to Locomotive Shops and Engine Terminals and their equipment has been rewritten and expanded. Eleven chapters cover the work of the machine shop in detail. Additional chapters are included on the boiler shop, machine forging work, material handling and the engine terminal.

In this edition, there are three entirely new chapters on the maintenance and servicing of Diesel-electric locomotives. The character of the facilities needed by railroads operating this form of motive power is rapidly taking a definite pattern and these chapters represent an accurate cross section of the many problems involved in Diesel maintenance and a guide to their ultimate solution.

The chapter on Welding and Allied Operations has been completely rewritten and broadened in scope to include examples of the latest practices in flame hardening and shape cutting.

SAFETY IN ELECTRIC AND GAS WELDING AND CUTTING OPERATIONS. *By American Standards Association. Published by American Standards Association, 70 East 45th street, New York 17. 31 pages. Paper covered. Price, 40 cents.*

This is a war standard developed by a committee representing all fields of interest in the use of gas and electric welding. More than 750 manufacturers and users of welding and cutting equipment have reviewed the material presented to them and the complete work in its requirements has been generally acceptable to them. Certain of the features in it relating to ventilation are open to further study according to the committee but all others can be regarded as representing practices on which there is general agreement. Standards are set for the installation and operation of gas-welding and gas-cutting equipment; installation and operation of arc-welding and arc-cutting equipment; installation and operation of resistance-welding equipment; fire prevention; protection of personnel, and, ventilation and health protection. All recommendations are given in a clear and concise manner and the pamphlet is one with which safety and welding supervisors should be familiar.

With the Car Foremen and Inspectors

Wreck Train Equipment

R. Schey, Chairman

A complete description of the tools and facilities needed—Bunks for 16 men recommended

The requirements for wreck train equipment are of such character that it will generally come under two classifications; namely, No. 1 and No. 2 Trains.

No. 1 wreck trains should have a general make-up behind the locomotive in the following order: one truck car—all-steel flat car; one steam derrick—150 to 250 tons capacity; one idler car—all-steel flat car; one tool car—steel underframe box car; one fire-fighting car—steel underframe box car; one dining-cook car — steel underframe coach or box car; one bunk car—steel underframe box car.

Features of the Derrick

The derrick must be so constructed that it will clear all lines over which it is assigned and must not exceed the capacity for trestles, bridges and track without special authority.

The capacity of the derrick should be sufficient to handle the power dependent upon it—steam, electric, or Diesel. With larger and heavier power coming into use on many roads, greater capacity derricks are preferable and will work to better advantage with excess lifting power rather than working too close to capacity.

The steam derrick and all of the cars in the wreck train should be equipped with standard couplers, yokes and draft gears.

Derricks should also be equipped with electric lights and air-operating valves on both sides for the use of groundmen. Locking devices for outriggers should be effective and of such design as to prevent shifting when the derrick is in train movement.

Fire-Fighting Cars

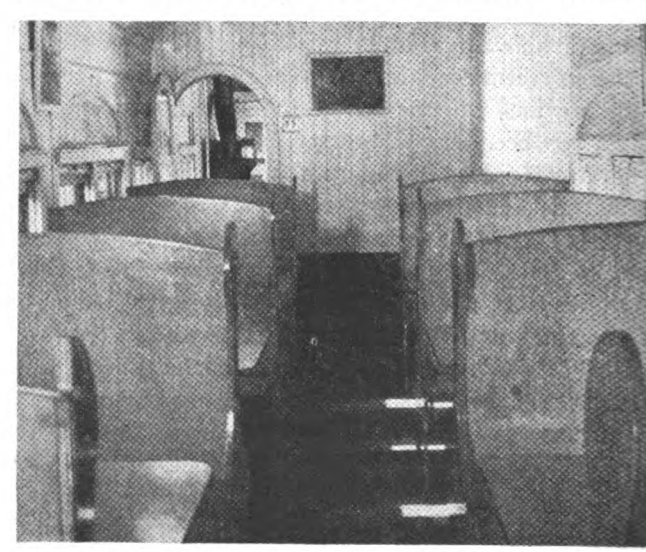
A recent addition to Class I wreck trains is a fire-fighting car completely equipped with fire-fighting apparatus to combat oil, gasoline and other fires at wrecks. This fire-fighting unit should be complete so that it can be operated without depending upon any equipment in the wreck train proper in the event it is desirable to operate the fire car to the scene of an accident at a much greater speed than is permissible for heavy wrecking derricks.

Combatting oil fires requires special foam-generating equipment, gasoline or steam pump, water supply, fire hose, firemen's equipment such as boots, coats, helmets, gas masks, asbestos suits, etc. Also first aid equipment for emergencies.

The truck car should be of all-steel construction substantial in design. The wood floor should have rails laid, shimmed up over the top of the floor so that cinders and dirt can be blown out easily. Wreck trucks should be placed on the rails and properly anchored to prevent movement in transit. In addition to the required safety appliances, the addition of vertical hand holds makes it easier for wreck-train employees to get on and off the truck car.

Underneath pockets or lockers, for heavy outrigger blocking, ties and wedges are very beneficial in loading and unloading and save a considerable amount of time and labor. Some wreck trains have an additional block car for this purpose.

Ten extra rails are also carried on the floor of this car. Removable stakes are provided so that rails can readily



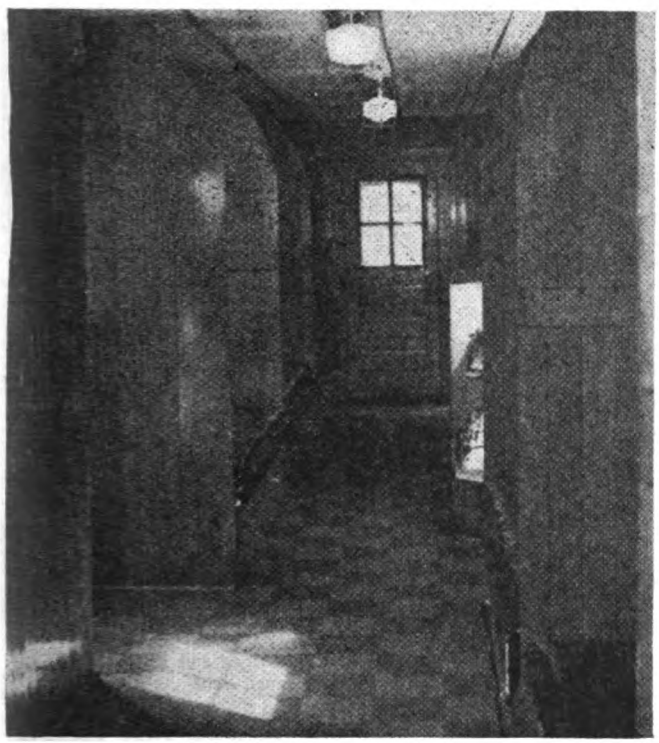
Dining room, looking toward the kitchen

* Abstract of a paper prepared for the 1944 year book of the Car Department Officers' Association.

be rolled off the car. End stops keep the rails on the cars. Some railroads carry an extra rail-and-tie car for this purpose.

Idler Car

The idler car should be of all-steel construction and substantial in design. A wood floor should be provided and the car equipped with heavy lift cables, various



Bunk car with upper bunks raised and lockers partly showing

hooks required for different jobs, lifting beams for loaded and empty cars and passenger cars. Extra key-attachment couplers are also carried. This arrangement saves lifting of heavy cables and hooks, and saves valuable time and labor.

Underneath lockers about 14 ft. long are provided on each side, divided into compartments. The compartments, each labeled, contain such equipment as replacers, truck chains, jacks, journal wedges and bearings, center pins, complete oxyacetylene cutting outfit with 100 ft. of hose. The gas tanks are mounted on a carrying litter so that the outfit can readily be carried by two men. Hose is of such length that most cutting can be done without removing the carrying litter from the locker. Regulators, hose and torch are always connected up ready for instant use, but the valves on the tanks are kept closed to prevent damage to regulator diaphragms. All replacers are equipped with rail clamps to avoid spiking.

The idler car is equipped with an auxiliary water tank for the steam derrick. This auxiliary water supply is beneficial in keeping the derrick operating and eliminates time out for syphoning water from the locomotive tank. Water from auxiliary tanks is forced by air pressure from the train line and water is supplied to the wrecker tank by a hose laid along the idler car. Air pressure is controlled with a feed valve set at 15 lb. pressure. A gauge is supplied to avoid damage to the water tank. A vent valve is also supplied to vent air pressure after water is taken. Another advantage of forcing water by air pressure rather than syphoning is that the water is not heated and the injectors on the derrick will work more efficiently.

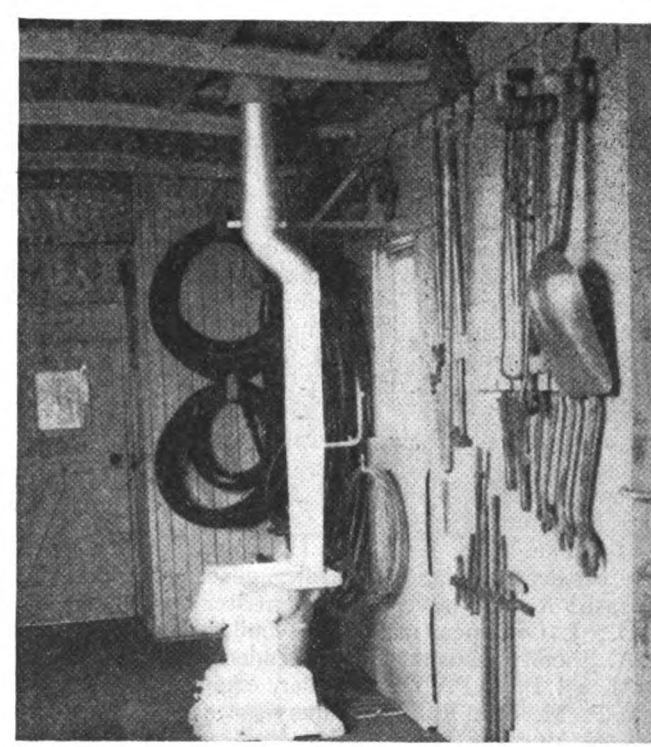
Tool Car

The tool car is a box car fitted with racks for various equipment, such as cables, chain hoist, small blocks, wood wedges, portable electric-light generator with two 500-watt floodlights and one 250-watt spot light, sledges, hammers, wrenches and various hand tools, journal jacks and body jacks, bolts of various sizes, air hose, pipe nipples, etc., assortment of special links, hooks, pulling knuckles, corner protectors, etc., bench and vise for emergency repairs, dry hopper for use of men when the camp car is not brought to the actual derailment, car oil, dope and other supplies and tire-setting equipment.

This car is equipped with side doors in addition to end doors. Underneath lockers are provided for additional equipment and extra oxygen and acetylene cylinders. A second complete oxygen-acetylene cutting equipment is provided with long and short cutting torches. A heating stove is provided. To facilitate handling heavy equipment in and out of the car, a rope falls, mounted on a swinging arm, is provided at each side door. Platform steps and additional hand holds at each doorway facilitate entering and leaving the car.

A different color is assigned to each wreck train for painting various hooks, cable sockets, small tools, etc. In the event two or more wreck trains are working together it will be easy to identify tools and equipment belonging to each outfit when ready to pick up tools and equipment. This avoids argument and keeps each wreck train completely equipped with standard tools.

All cables are provided with drop-forged zinc-poured open-end sockets. With this arrangement two and more cables can be combined with links and pins to provide a cable of any length for pulling or rolling cars away from the right of way. This eliminates handling of awkward long cables and in the event a cable is damaged, only a short section will be scrapped. Special cables such as drawbar slings, bridle slings, chokers, etc., have recently been provided, made of braided wire rope. These braided ropes are more flexible and lighter than



Tool-car room

conventional plow steel cables. It is important that pure virgin zinc be used for rope attachments, as babbitt and substitute materials will not give adequate lifting capacity.

Bunk Car

The bunk car is a 40-ft. box car equipped with double-deck Pullman-style beds. Accommodations are provided for 16 men which takes care of the regular wreck crew as well as extra men such as machinists, etc., who may accompany the wreck train. There is an individual locker for each member of the wreck crew. Large drawers are built in underneath lower beds for storage of clean linen and blankets. When beds are not in use, mattresses and pillow cases are kept covered with canvas to keep them clean. This canvas is removed when beds are made up for use. Bunk cars are equipped with electric lights.

Dining and Cook Car

A steel underframe coach or dining car is used. The general floor plan provides for a complete kitchen built in at one end. The kitchen contains a dining-car range, ice boxes, sink, work table, cupboards for storage of dishes, staple groceries and silverware, flour bin, potato bin, space for garbage cans, etc. Hot and cold running water is supplied in the kitchen from overhead tanks. These tanks can be filled from the ground with a standard coach watering hose or garden hose with the use of adapter fittings.

The dining room, next to the kitchen, is equipped with four-seat tables along both sides of the car with an aisle between. A partition and door is provided between the dining room and the washroom which is equipped with lavatories, enclosed shower, enclosed flush type toilet, etc. The water is supplied with overhead tanks and a coal water-heater is installed for heating wash water.

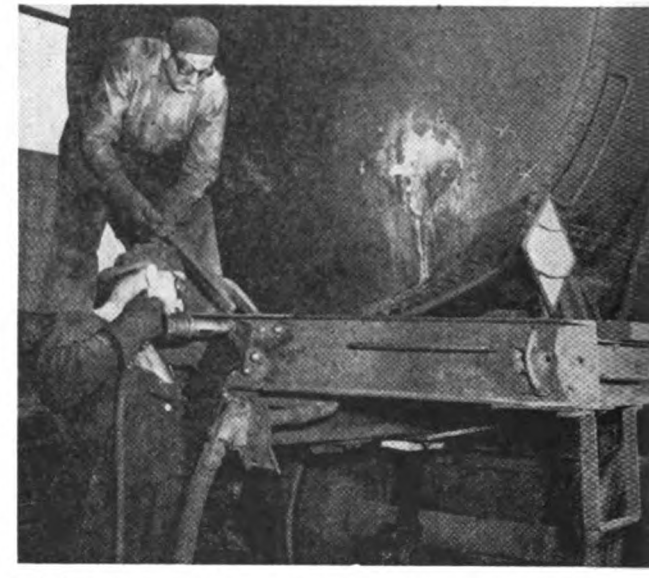
At the opposite end of the car there is a private office for the wreck foreman. This office contains a double-deck bed for the wreck foreman and assistant wreck foreman, a desk, a cupboard for stationery and instructions, clothes lockers, etc. It also is equipped with electric lights supplied by batteries and an axle generator to keep the batteries up while running.

No. 2 wreck trains have a general make-up behind the locomotive in the following order: one truck car—all-steel flat car; one steam derrick—75 to 100 ton capacity; one idler car—all-steel flat car; one tool car—steel underframe box car; one dining-camp car—steel underframe coach; and one bunk car—steel underframe box car. (The bunk car is furnished only on wreck trains when the dining and camp car is not of sufficient length to accommodate bunks for the men.) Equipment and general make-up of No. 2 wreck trains is similar to No. 1 wreck trains with the exception of the size and amount of various cables and slings, lifting beams, etc.

The report was signed by R. Schey, chairman, supervisor car maintenance, N. Y. C. & St. L.; W. T. Wright, car foreman, C. & E. I.; H. H. Young, general foreman, car dept., I. C.; A. L. Miller, general car foreman, Wabash; R. B. Fisher, regional master car builder, B. & O.; J. Grimmer, master car builder, E. J. & E.; F. A. Shoulty, assistant superintendent car department, C. M. St. P. & P.; H. J. Baker, equipment inspector, cars, P. M.; W. R. Hall, supervisor car maintenance, C. & N. W.; and L. W. Dobbins, general car foreman, N. Y. C.

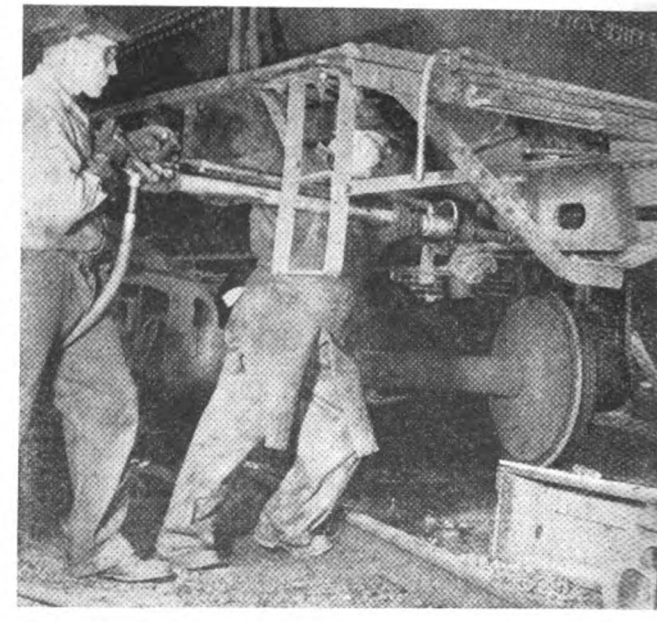
Tank Car Repairs*

One of the most serious problems facing the Petroleum Administration for War during the early days of the war was the transportation of petroleum and its products from the oil fields and refineries of the Southwest to the Eastern Seaboard which, until the war, had depended upon oceangoing tankers for 98.5 per cent of its supply. In converting to overland transportation, it became essential to move tremendous quantities of petroleum and refined



Workmen effect quick repairs to the damaged end sill of a tank car at the Twin Oaks repair yard

products in railroad tank cars. Between 1941 and 1943 railroad transportation of petroleum to the East Coast was revolutionized so that by June of the latter year more



At the Marcus Hook repair shop the bent center sill of a tank car is straightened and then reinforced, using an extended-handle air hammer

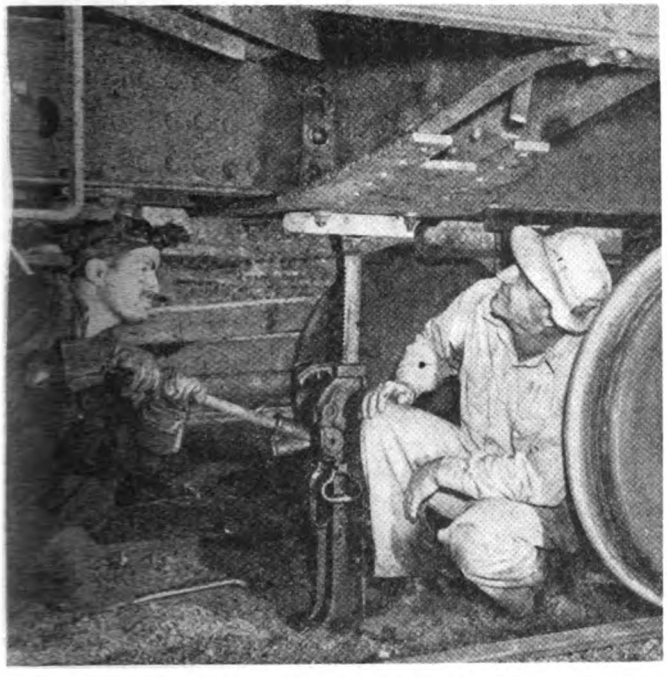
than 80,000 of the nation's 107,000 tank cars in petroleum service throughout the United States were in this service.

Innumerable problems resulted from the evolution. The

* From information furnished by the Petroleum Administration for War, Washington, D. C.

Petroleum Administration urged the oil industry to exercise all of the ingenuity at its disposal to keep the cars rolling. The following article describes how one company, disregarding the additional costs involved, has met this challenge by developing a program of tank-car repairs that eliminates the delay of sending equipment to repair shops, thus greatly reducing turnaround time and increasing deliveries.

At two principal terminals, the Sun Oil Company has



While still on the repair track, this damaged tank car gets a new body — bolster cover plate — Quick repairs have greatly reduced turnaround time

installed facilities to do speedy repair work right on the tracks, instead of sending the cars to railroad shops. Exclusive of investment, this work is costing Sun $300,000 a year more than the allowable cost set by the Association of American Railroads.

The results, according to traffic executives in charge of such repairs, is an efficiency in tank-car handling at least 50 per cent greater than the average. The turnaround time between company terminals at Twin Oaks, Pa., and Meraux, La.—a round trip of nearly 3,000 miles—has been cut to less than 12 days. Sun's average delivery of crude oil per tank car per day on this run is 19 barrels, as compared with the average of 12 barrels for the same distance for the industry as a whole.

The importance of this margin to the war-time oil supply is emphasized by the volume of the company's tank car traffic, which in 1943 amounted to 350,000,000 mi.

Though construction of the Big Inch and Little Big Inch pipelines under direction of the Petroleum Administration for War has greatly eased the situation on the Atlantic seaboard, substantial railroad tank car shipments are still necessary. Rail movement of oil products is expected to take on added importance as increased quantities have to be delivered at Pacific Coast ports for enlarged operations against Japan.

Benjamin P. Atkinson, Jr., general foreman of both the on-the-track repair yard at Twin Oaks and of Sun's heavy repair shops at the Marcus Hook, Pa., refinery, has this to say:

"We work night and day, seven days a week. These cars are taking an awful pounding, but we have to make permanent repairs and get them rolling again, and that applies to a good many cars that would simply be scrapped in time of peace.

"The most common damage is a cracked or bent centersill, which can be caused by suddenly braking a train, by pushing a heavy string of cars over a grade, or other kind of rough handling.

"For leaks in the tank we have curved plates all ready to rivet on.

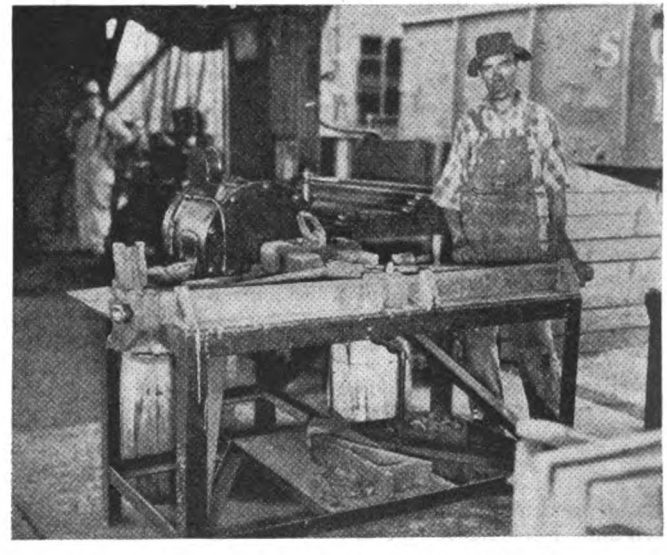
"Most of our men have been trained right here. They come from all kinds of occupations, and many of them had never done any mechanical work or even physical labor before. But during 1943, we managed to make 37,222 tank-car repairs at Twin Oaks, and 2,000 repairs were made at Meraux, La."

Meraux is one of a number of new loading installations that are a part of Sun's war effort. They receive crude oil by pipeline and barge, and are so located as to reduce substantially the rail tank car mileage. The Twin Oaks repair yard is also an unloading siding, serving the Marcus Hook refinery.

Brake Beam Assembler and Tester

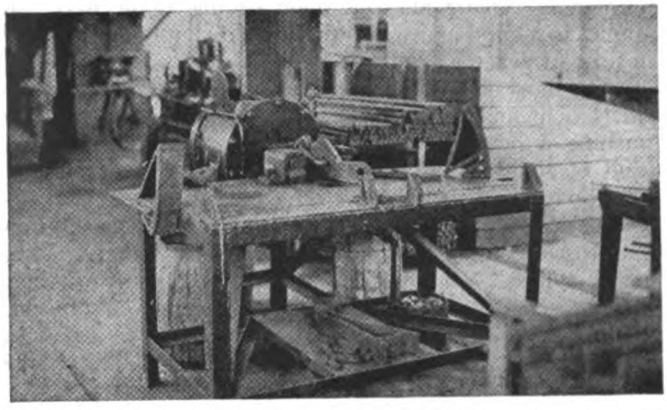
The assembly and testing of brake beams is carried on at the Chattanooga, Tenn., car shop of the Southern on a single table which has been designed to serve both uses. The table top is equipped with all necessary stops and blocks for the assembly operation and the fittings needed for testings are readily set in place when that work is being done. The power source for both assembly and testing is an air cylinder mounted horizontally and equipped with a two-way control valve and a pressure gauge.

When beams are being assembled the channel section and fulcrum are properly positioned against the table stops. The truss rod, threaded but not bent, is next



Truss rods are bent with a forming die fastened on the air cylinder piston

placed in position and the admission of air to the cylinders advances a vee-shaped die which bends the truss rod to the proper angle and holds it in position while the brake shoes are applied and the holding nuts drawn up tightly.

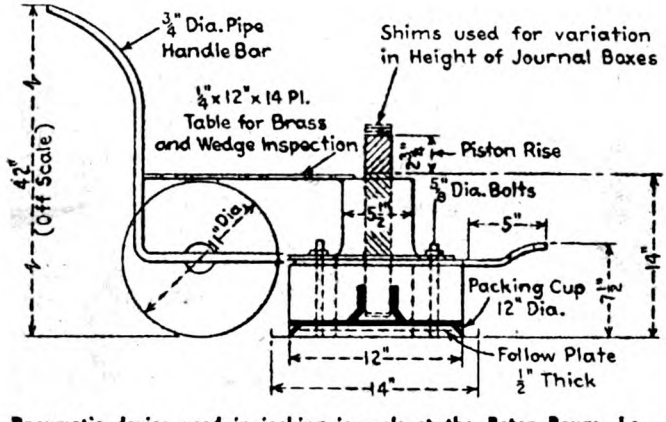


Assembly and testing work is all done at this work table—One of the holding shoes for the tension test is shown in position at the left side of the table

After a beam has been assembled it is tested by attaching a hook to the air-cylinder piston through which the test force is applied to the beam as the piston is reversed. The beam is held in position on the table for this operation by a pair of demountable shoes which are slipped into slots on the table. The brake heads fit against these shoes which have the same contour as the backs of standard brake shoes.

Pneumatic Journal Jack

The ingenious and time-saving pneumatic journal jack, illustrated, won a suggestion award for its designer, a carman employed at the Baton Rouge, La., car repair tracks of the Illinois Central, as described in the Illinois Central magazine issue for September, 1944. The new

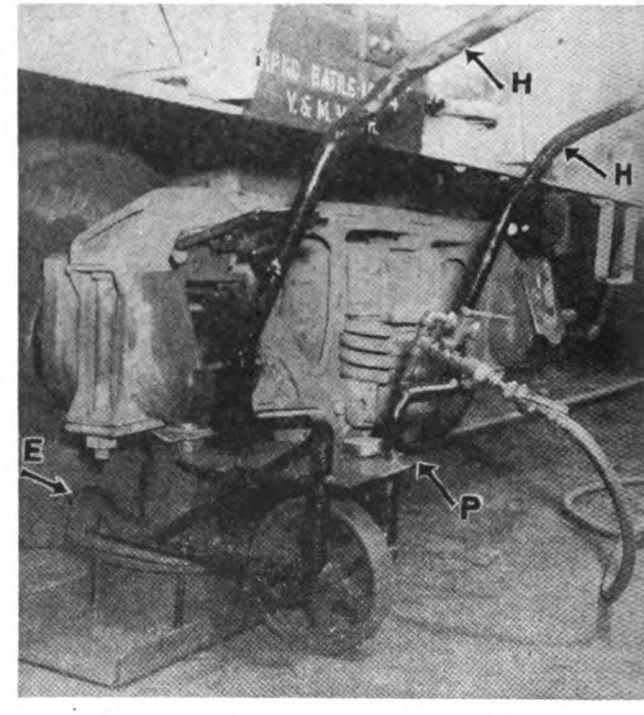


Pneumatic device used in jacking journals at the Baton Rouge, La., car repair tracks of the Illinois Central

jack is described as a decided improvement over the hand-operated standard car jacks formerly used in repacking journals at this point.

The jack consists of an air-brake cylinder with a 12-in. piston and non-pressure head, the cylinder being reduced to 4½ in. in length and welded to a 14-in. by 30-in. flanged base plate. Four ⅝-in. bolts welded to the base plate extend upward through the non-pressure head of the brake cylinder and engage the flattened ends of two braced 1-in. pipe sections which serve as the frame of the device, supporting a single 11-in. truck wheel in bearings just outside the brake cylinder and being offset, bent and extended upward to form handle bars *HH* which are 28 in. apart and 42 in. high at the upper ends. A ¼-in. by 12-in. by 14-in. plate *P* rests on one end on the brake cylinder and is cut out at the sides so that it fits in between, and serves to space the two pipe-frame sections to which it is welded. This plate makes a convenient table for the inspection of journal brasses and wedges.

Extension plate *E* which projects 5 in. beyond the



Pneumatic device used in jacking journals at the Baton Rouge, La., car-repair tracks of the Illinois Central

brake cylinder serves to position the jack when it is rolled under the journal box and also tends to hold the wheel down against any possible lifting tendency during the jacking operation. Round steel shims of varying thickness are used to take care of varying journal-box height and one of these shims is shown in the illustration resting on plate *P*. Admission of air to the brake cylinder during the jacking operation is controlled by means of a small cut-out cock in the hose line which is, of course, closed when the journal box has been jacked up to the desired height. The box can be easily lowered any desired amount until it rests on the wedge and brass by exhausting air from the cylinder through the other air cutout cock illustrated.

This device has the important advantage of being easily portable for movement by one man anywhere about the car shop or car repair tracks. It can be inserted under the journal box with a minimum of physical effort and no time need be lost looking for wood planks or blocking material. The actual lifting operation also requires absolutely no manual work and is done in minimum time.

This journal jack is said to be practically fool-proof in operation and there is no danger of slipping. The only necessary precaution is keeping fingers out of the journal box while it is being lowered onto the wedge and brass and any responsible carman will know enough to look out for that.

Servicing on Through Runs*

E. G. Sanders

By E. G. Sanders†

Adequate and suitably located terminal and intermediate facilities cut down assignments

The two most important considerations in connection with installation of servicing facilities for locomotives used in long through runs are, first location and, second, design of the facilities so that all servicing operations can be performed with one spotting of the locomotive. Servicing facilities at intermediate stations should be located on the main line tracks where operating conditions will permit. This is particularly important for passenger locomotives.

Water cranes should be provided that will deliver water to the locomotive tender at a rate fast enough to fill the largest capacity tender in 3½ min. The minimum delivery rate for water should be not less than 4,000 gals. per min., and with tenders having a water capacity of 20,000 gals. or more, the delivery rate should be over 5,000 gals. per min. Water cranes are now in service that can deliver 7,000 gals. per min.

Delivery of fuel should be accomplished within time required to fill the tender with water, or not to exceed 3½ min. For coal-burning locomotives, this requires swinging aprons or spouts that will permit filling the tender without moving the locomotive. Installations have been made where the spout swings parallel with the track that will deliver 42 tons of coal in 75 sec. The fast delivery of fuel oil to oil-burning locomotives requires oil cranes capable of delivering 1,000 to 1,200 gal. of fuel oil per min. Heavy fuel oil generally used on oil burning locomotives must be maintained in the wayside supply tanks at temperatures ranging from 130 to 160 deg. F.

* Abstract of a paper prepared for the 1944 year book of the Railway Fuel and Traveling Engineers' Association.

† Fuel conservation engineer, Atchison, Topeka & Santa Fe.

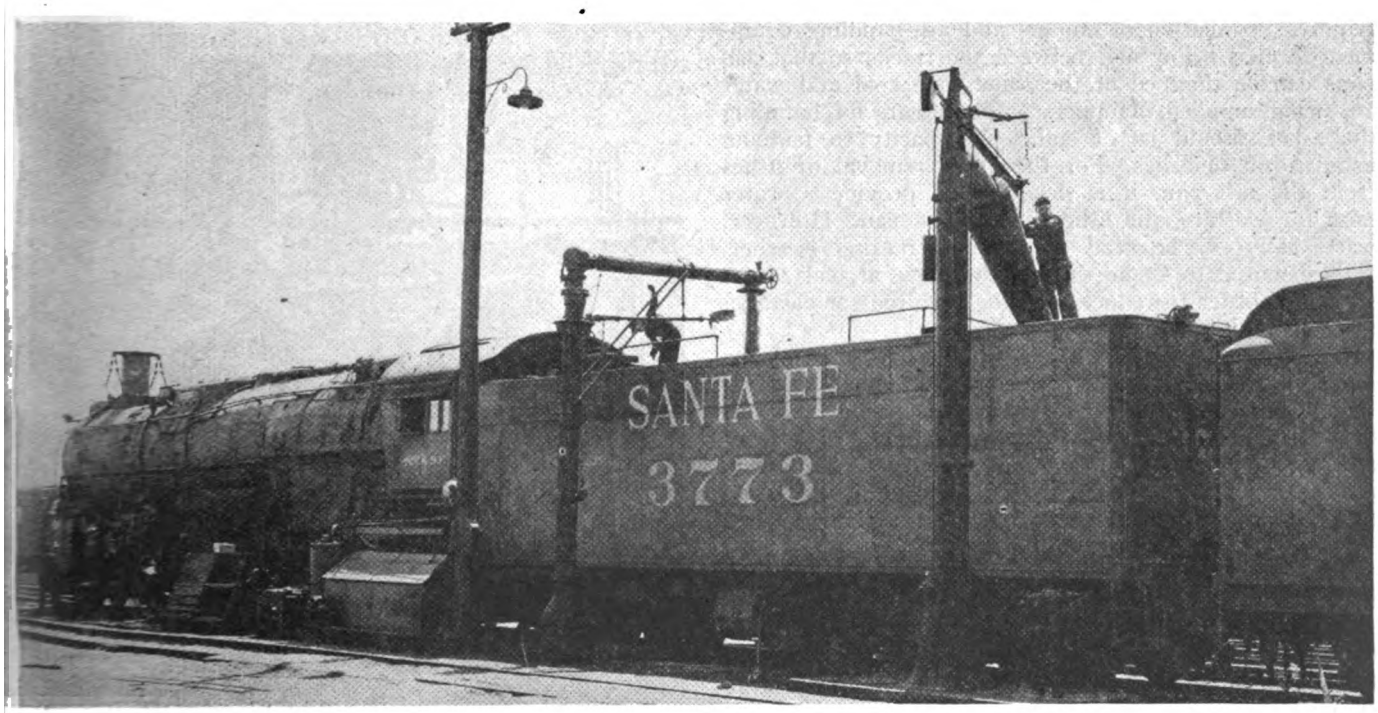


Fig. 1—Servicing an eastbound passenger locomotive at a station stop—Similar facilities for westbound trains are located at the opposite end of the platform

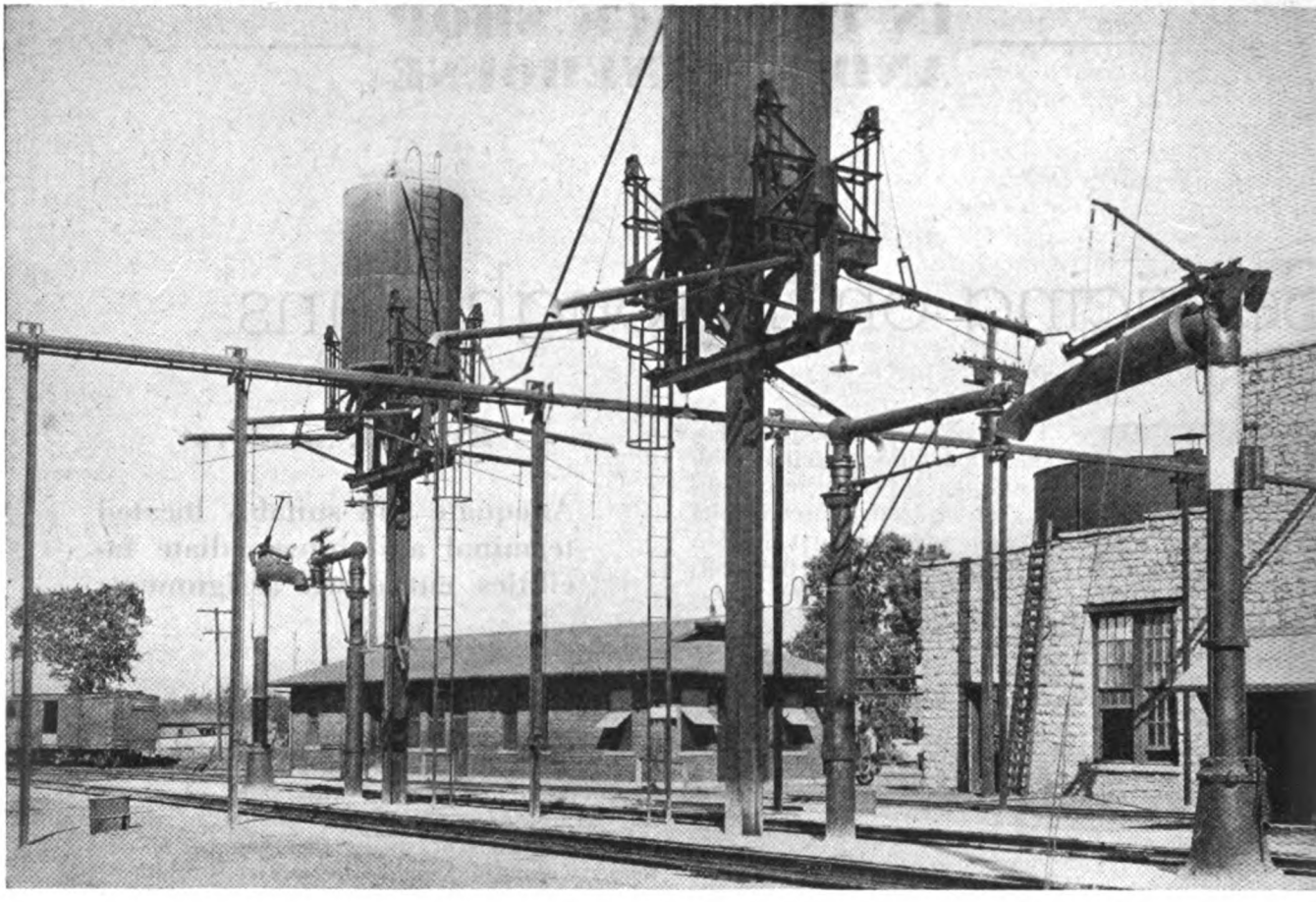


Fig. 2—High-speed servicing facilities for oil-burning freight locomotives at an intermediate terminal

to assure this fast delivery. This is also necessary so that no steaming difficulties will occur due to the oil being too cold to flow to the burner or too heavy and thick to atomize properly.

The dumping of ash pans on coal-burning locomotives requires installation of cinder- and ash-handling equipment located below and between the tracks so that ash pans can be dumped at the same time coal and water are being supplied. Hoppers or dump cars for handling the ashes should be of sufficient capacity to take an ash-pan-full of ashes. For the quick removal of ashes from the ash pan, it is desirable to provide a water hose for washing the ashes out of the pan. However, water can only be used during non-freezing weather. It is essential to shake the grates before arrival at the station in order to reduce the time required for cleaning fires to a minimum.

Sanding facilities should be provided at some of the more important servicing stations. Adequate sanding facilities are particularly important at stations where oil-burning locomotives are serviced. Facilities for delivery of sand to oil-burning locomotives should have two overhead sand bins or reservoirs so rail sand can be delivered to the sand dome simultaneously with the delivery of flue sand to the sand box on the oil tank.

Rapid servicing of locomotives at the initial and final terminals is just as important as it is at intermediate servicing stations en route. The heavy traffic now being handled by all railroads due to the war has doubled and trebled the number of locomotives turned at most large enginehouses. Serious congestion will occur at such terminals if the locomotive servicing facilities are inadequate or not properly located.

[The author here referred to an article in the September 2, 1944, issue of the Railway Age describing improvements which were made at the Armourdale, Kan., terminal of the Chicago, Rock Island & Pacific.—EDITOR]

The high-speed facilities for servicing oil-burning

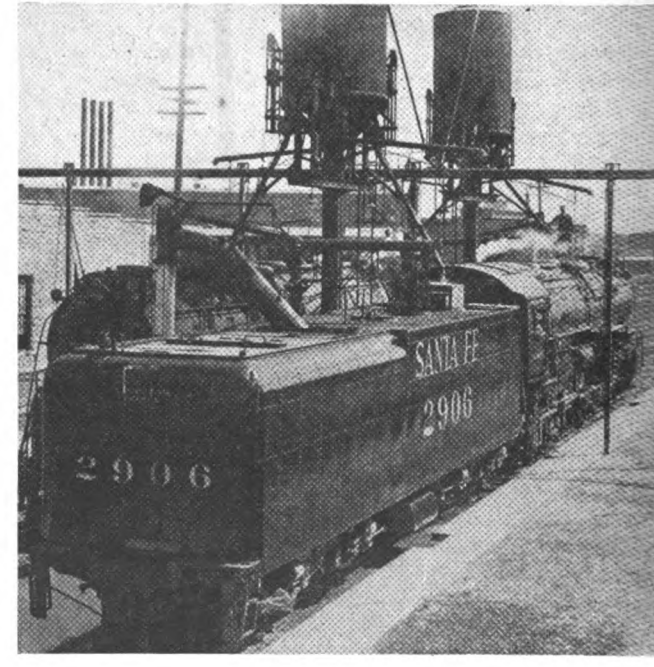


Fig. 3—Fuel oil, water, track sand and firebox sand being delivered to two locomotives simultaneously

steam passenger locomotives shown in Fig. 1 serve eastbound passenger locomotives. They are located at the east end of a passenger station platform so all servicing operations can be performed while the train and locomotive are standing at the station. Similar facilities are located at the west end of the passenger station platform for servicing locomotives on westbound passenger trains. It will be noted that two employees are supplying fuel oil and water to the locomotive and that other employees are lubricating the main- and side-rod bearings with high-speed air-operated grease guns. Other operations performed include inspection of the locomotive, checking of lubricating oil in driving and journal boxes, removal of carbon from firebox and replenishment of miscellaneous supplies. The locomotive is standing over an inspection pit which is provided with electric lights and is of sufficient depth so the inspector can make underneath inspection standing in the pit. It requires an average of eight minutes for complete servicing of a locomotive at this station. The servicing time can be reduced to five minutes if necessary.

This passenger locomotive handled a train from Los Angeles, Calif., to Kansas City, Mo., a distance of 1,791 miles. Locomotives of this type operate on six daily trains (three westbound and three eastbound) between Kansas City and Los Angeles. Twelve different engine crews are required to handle one train between these points. Fuel oil is supplied en route six times westbound and five times eastbound and water supplied sixteen times in both directions. Enginehouse employees meet the locomotive at eleven intermediate terminals where engine crews change to inspect and service the locomotives. The locomotives used on these long runs average from 13,000 to 14,700 miles per month per assigned locomotive and 15,300 to 19,500 miles per month per active locomotive.

Railroads operating coal-burning locomotives on through passenger runs usually locate intermediate servicing facilities some distance from passenger stations to avoid the dust and dirt incident to the handling of coal and ashes. This involves extra stops for servicing. To reduce the delay to a minimum, coal docks have been designed and installed that deliver 42 tons of coal in 75 sec. The fast delivery of coal is accomplished by the use of a spout (called a bootleg) that swings lengthwise of the track. A hopper is installed underneath the track with sufficient capacity to hold all of the ashes in the ash pan. Water is delivered at the rate of 3,500 gals. per min. The delivery of fuel and water and dumping of the ash pan is performed at one spotting of the locomotive.

Freight locomotives operating on long through runs usually do not use the servicing facilities installed for passenger locomotives. The general practice of handling freight locomotives at intermediate terminals where engine crews change, is to uncouple the locomotive from the train and bring it to the enginehouse for servicing and supplies. Servicing facilities should be located on tracks adjacent to or near the enginehouse where the locomotives can be moved to and from the trainyard with minimum delay.

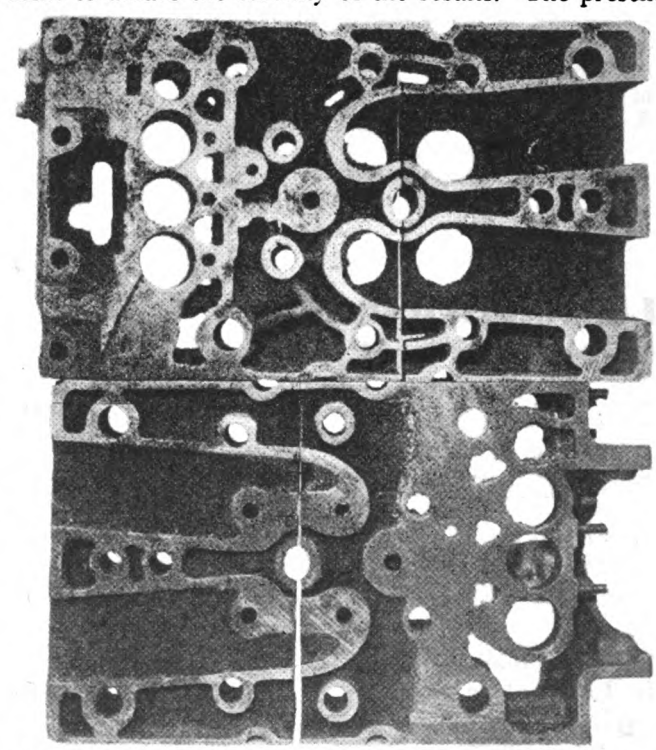
Facilities for servicing freight locomotives should be designed so all servicing operations can be performed in the shortest possible time. A minimum of two servicing tracks should be provided and the facilities so arranged that locomotives can be serviced with one spot in either direction on both tracks.

An installation of high-speed servicing facilities at an intermediate terminal for oil-burning freight locomotives is shown in Fig. 2. Water, fuel oil and sand are being furnished simultaneously. An oil-burning locomotive requires sand for cleaning flues in addition to rail sand. It will be noted that two sand spouts are provided so rail and flue sand can be supplied without moving the locomotive. Fig. 3 shows two locomotives being serviced simultaneously. These locomotives operate in freight service on through runs between Argentine (Kansas City), Kan., and Clovis, N. M., a distance of 637 miles, which is the longest through freight run on the Santa Fe. There are twenty-five locomotives of this class in this assignment and they are making 8,000 to 9,000 miles per month per assigned locomotive. It would not be possible to obtain such high mileage without the installation of high-speed servicing facilities. Without these facilities it would be necessary to relay the locomotives at two intermediate terminals and this would necessitate keeping two relay locomotives at each of these two terminals, or would require an assignment of twenty-nine locomotives to make the same mileage now being made by twenty-five locomotives.

The cost of installing all the new servicing facilities between Argentine, Kan., and Clovis, N. M., was considerably less than the cost of one new locomotive. This emphasizes the importance of installing new servicing facilities or improving existing facilities when new locomotives are purchased.

Chemical Treatment of Diesel Engine Cooling Water

The Reading Company is now treating chemically all water employed in the cooling systems of Diesel-electric locomotives. The work is done under the supervision of a field chemist assigned from the railroad's test department to insure that chemicals are used in the proportions required. He also makes periodic checks of the treatment to assure the stability of the results. The present



Condition of Diesel-engine cylinder head from a unit in which water treatment was employed—Water passages are clean—The dark appearance of the water jacket results from the inhibiting action of the chemicals used

work was started in 1939 when it was realized that cooling-system water should be treated to minimize corrosion in the cooling system. However, at that time, there was no existing standard or accepted practice or procedure in use.

Conventional chemical treatment used for steam-locomotive-boiler feed water will not produce satisfactory results. The problems involved are different due to the higher pressures and temperatures employed in steam-locomotive operation. The reaction products of this type of treatment in steam-boiler feed water can readily be eliminated by blowing down the boiler. In the case of Diesel-electric-locomotive cooling water they can only be eliminated by frequent draining and flushing of the entire system.

Studies were made by the engineer of tests and various treatments were experimented with until August, 1941, when a chemical compound having a sodium dichromate base was adopted. Similar compounds to the one in use on the Reading are manufactured by a number of companies specializing in the chemical treatment of water. The compound is added in the proportion of 20 ounces to 50 gal. of cooling water.

The raw-water supply on the Reading has an average hydrogen ion factor of Ph 6.7 which is definitely in the corrosive range. After chemical treatment the Ph value average 8 which is definitely alkaline and represents a desirable condition to prevent corrosion. The compound used is very stable and, in general, will maintain a hydrogen ion factor of Ph 7-plus for approximately three months without additional treatment. However, in order that the condition of cooling water may be known at all times, test analyses are made by a field chemist and additional compound added if it is found to be needed. At three-month intervals the cooling system is drained and flushed thoroughly with plain water. The cooling system is then refilled and the proper amount of chemical added. This work is supervised by the field chemist.

The photograph shows a section cut through a cylinder head which was approximately six years old. All of the water passages are revealed to be clean, the dark appearance of the water jacket being due to the inhibiting action of the chemical treatment used. According to experience on the Reading, the prevention of corrosion and blocking of water passages not only prolongs the life of parts but also results in better operation from the standpoint of maintaining desirable engine temperatures.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Embrittlement In Locomotive Boilers

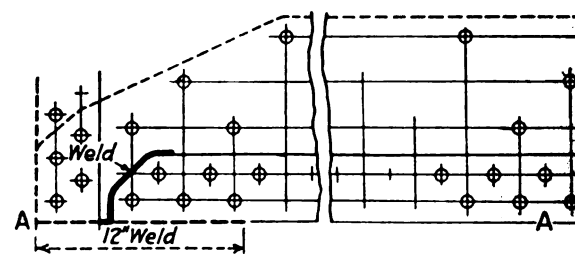
Q.—What protective measures can be taken against embrittlement in boiler plates and the seams of locomotive boilers?—D. E. V.

A.—On boilers in service the simplest protection is water treatment. The feed water can be checked by using an embrittlement detector and, if it is found to be causing embrittlement, proper chemical treatment can be added until the water is made non-embrittling. Embrittlement occurs only when the metal is under stress. Stresses can be structural, pressure, or cold working. Pressure and structural stresses in the seams should not be excessive if embrittlement is to be prevented. In fabricating the boiler the cold working of the shell course and seam welts should be kept to a minimum and extreme care should be taken when riveting so that cold working stresses are not set up in the metal due to high riveting pressures or excessive caulking.

Welding Longitudinal Seam

Q.—What advantages, if any, are obtained by welding the longitudinal joint of a boiler shell course before applying the inside and outside welt straps?—E. K.

A.—The welding of the longitudinal seam of the boiler shell course before applying the inside and outside welt straps is intended to insure a tight seam. It has been the practice to weld the ends of the longitudinal seams as



Longitudinal butt strap welded adjacent to the circumferential seam

illustrated to insure a tight seam and eliminate the necessity of caulking the outside welt strap adjacent to the circumferential seam of the next course.

The joint of the shell course to which the seam is attached is along the line *A-A*. Because the edges of the inside welt strap are not caulked, the tightness of the seam is dependent upon the caulking of the outside welt strap. The caulking and welding of the outside welt strap causes the seam to be tight at all points except in the short space between the end of the butt strap and the shell plate of the adjacent course. For this reason this area must be welded to insure a tight seam. The weld is usually made about 12 in. long. Extending this weld the entire length of the boiler course would insure a tight seam with the tightness of the seam not being dependent upon the caulking of the outside butt strap.

Crown Bolt Taps

Q.—Should the tap used in applying crown bolts have continuous threads the full length of the water space or should a short tap with long leads be used?—F. I. M.

A.—When the crown bolts to be applied are threaded on a turret lathe with both ends threaded at the same time it is better to use a continuous thread tap. When each end of the crown bolt is threaded separately it will make no difference if the short tap is used as the threads on one end may not line up in respect to those on the other end. The general practice is to use a short tap with a plain spindle of the required length screwed into the end of the tap. When using a tap with a plain spindle no attempt is made to synchronize the threads of the inner and outer sheets and it has been found by experience that the rejects because of stripped threads are negligible.

Welded Construction of Locomotive Wheel Centers*

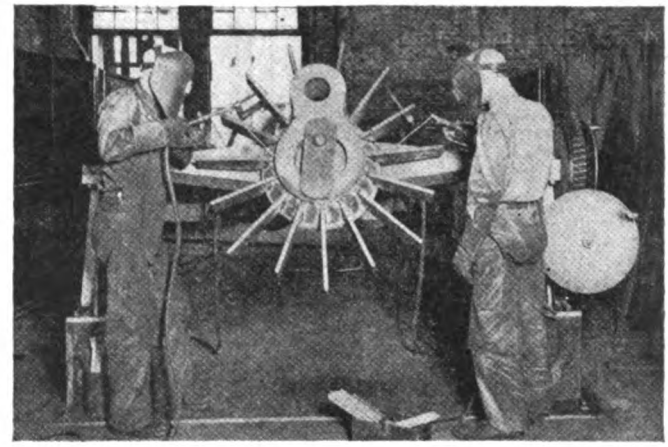
One of many successful adaptations of the electric-arc process is in the locomotive-wheel-center construction being done by the Pennsylvania at its Altoona, Pa., shops.

Component parts of the wheel-center assembly are made up of items ranging from short sections of small-diameter tubing to the large circular rim which is 2 in. thick. The hub section is 5 in. in thickness and other parts have a thickness of ¾ in. The members are flame-cut and roll-formed.

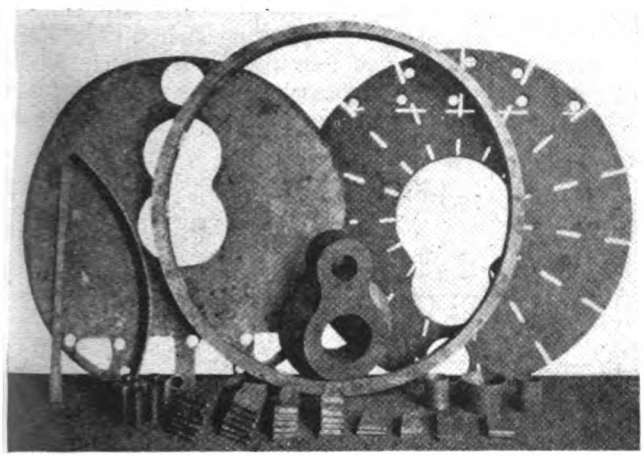
Spoke sections are of mild steel and they are made in two parts. The outside parts are tack-welded to the rim in a turning fixture designed to facilitate weld positioning. The inside sections are also tack-welded to the hub in the same positioner. After the tack-welding operation, finish-welding to the hub and rim is done in two passes using mild-steel electrodes. Rod sizes of 5/32-, 3/16- and ¼-in. diameters are used. Intermittent bead welds at the joints are applied in sequence to avoid overheating and possible distortion.

The rim and hub sections are then clamped in a jig and the veed ends of the spoke sections are welded solidly into single spokes. The joints on the spokes are double-veed and fused into one unit by applying 12 passes on each side. The assembly is again placed in the positioning fixture and two operators weld the spokes to the outside sheet of the wheel center. To avoid distortion when welding the mild-steel sheet to the high-carbon-steel rim and hub, the assembly is placed in a heating furnace to maintain the work at a temperature of 900 deg. F. The furnace is gas-fired and heavily insulated with asbestos. The inside sheet is then welded to the spokes by applying a plug weld in a single pass through slots in the sheet. This work is also done in the heating furnace.

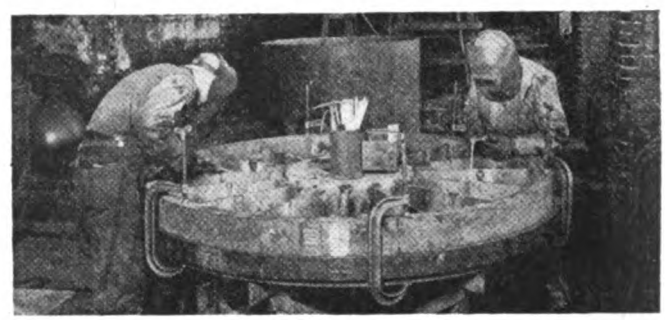
The total weight of the wheel center shown, after machining, was 2,670 lb. The assembly required the depositing of 205 lb. of weld metal.



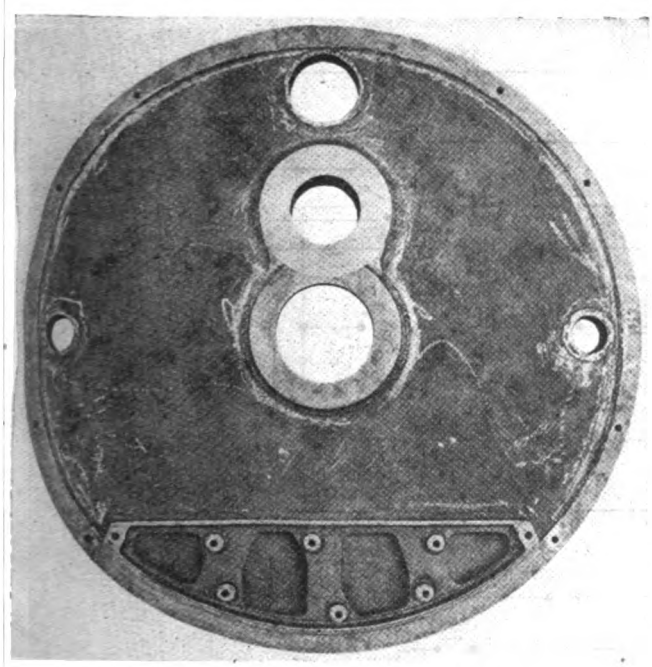
Welding half spoke to the hub section



The parts required are flame-cut and roll-formed



Spoke sections are joined by welding in a jig



Welded wheel center after machining

Elevated temperatures required for some operations are obtained in a gas-fired furnace

* Information and photographs from a field service report of the Lincoln Electric Railway Sales Co., Cleveland, Ohio.

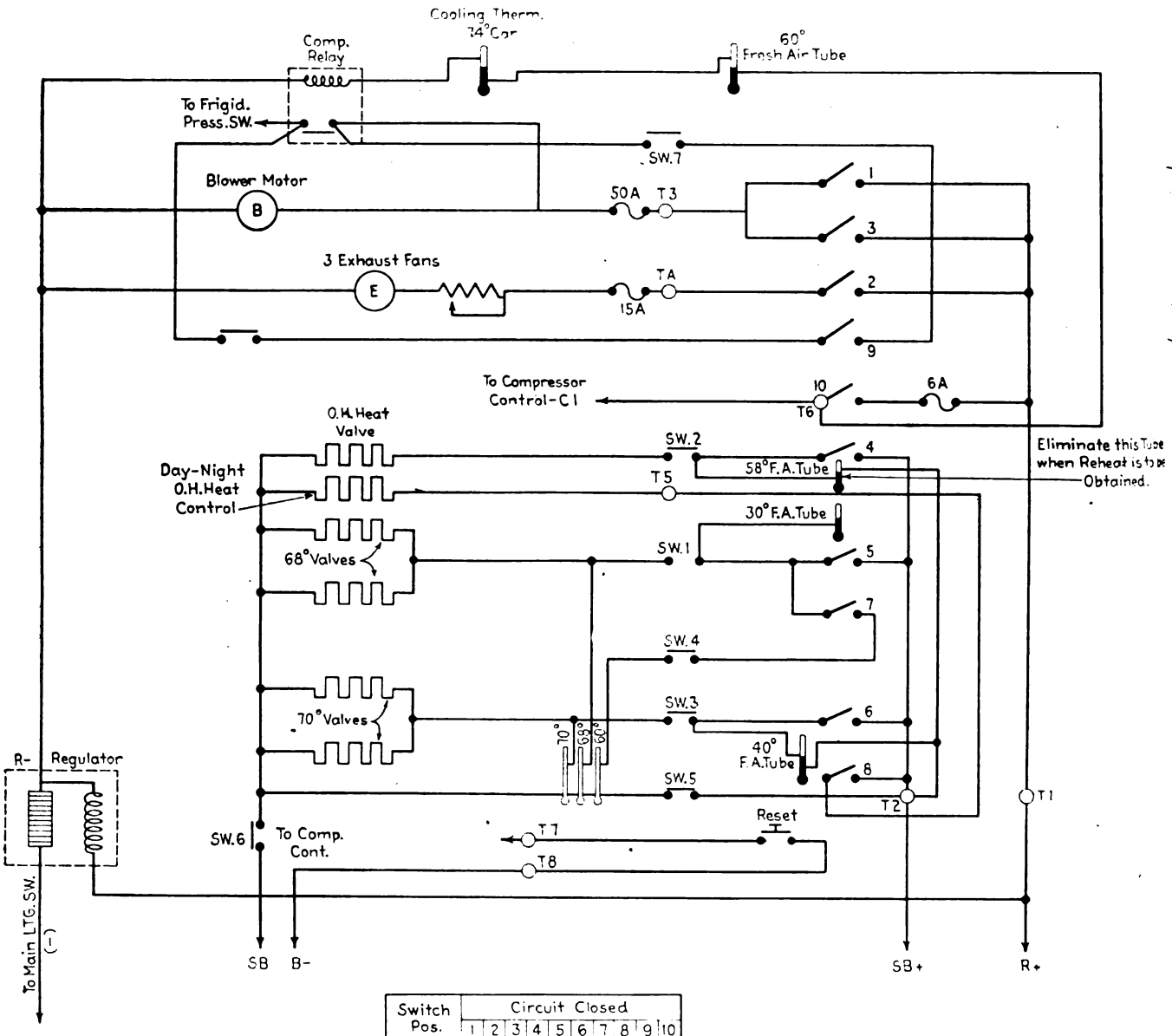
Simplified Control for

Heating and Air Conditioning

ON RUNS from New York City to Miami, Fla., or St. Petersburg, it is not uncommon, because of changes in climatic conditions, for the cars to require cooling when leaving New York City; heating during the night around Richmond, Va., and cooling again the next day. Although there is a porter assigned to each car, sometimes he and the train crew are too busy with other duties to change the selector switch, from *cool* to *heat* or vice versa, when the outside air temperature has dropped or increased sufficiently to necessitate this change.

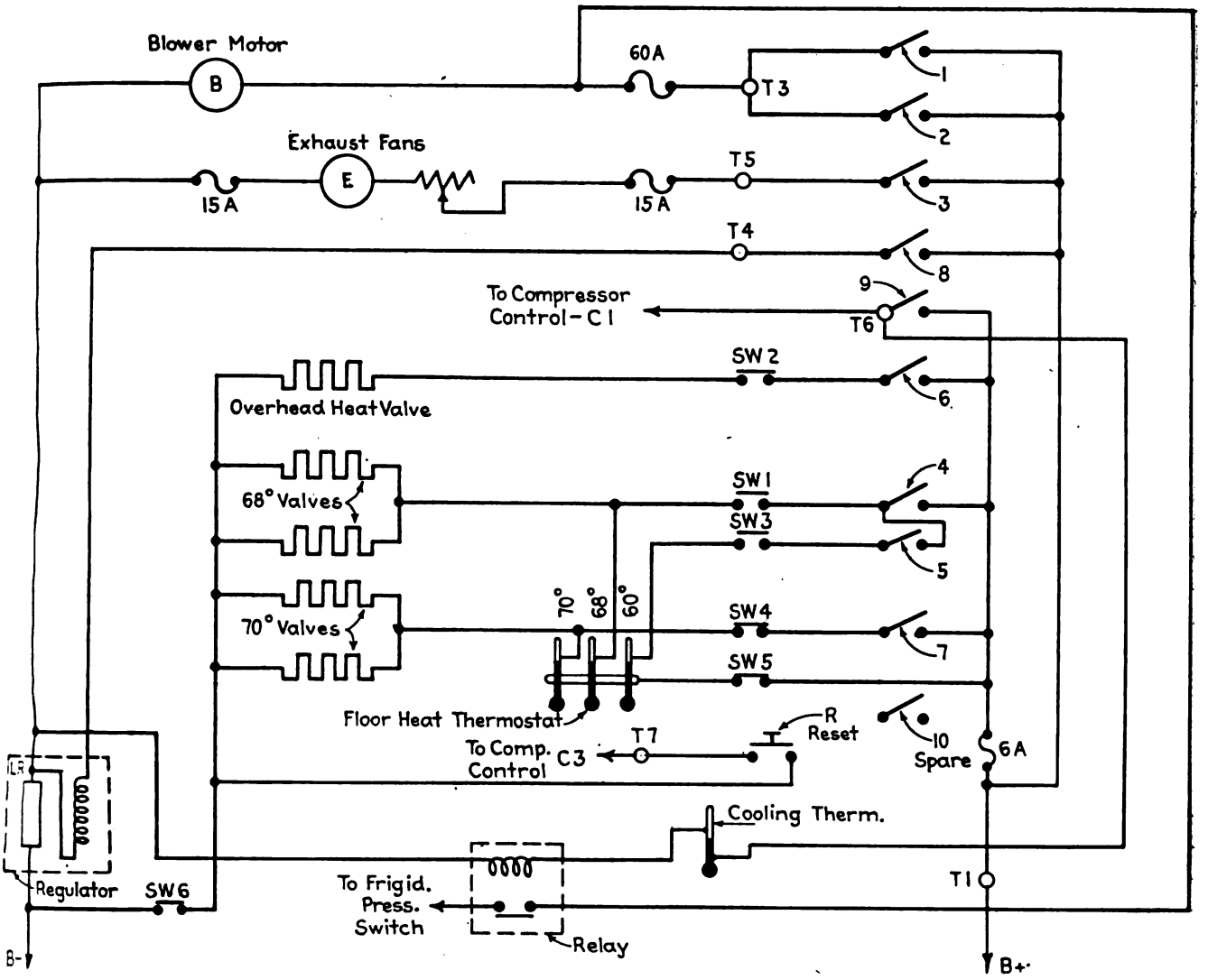
To eliminate, as much as possible, this manual operation of the selector switch on the control panel by the train crew, the Fulton Sylphon Company worked with the Seaboard Air Line to develop a control panel that would automatically set up the car for either heating, cooling or ventilation, completely independent of train crew operation and determined only by the climate the car encounters.

The control panel originally furnished by the Fulton Sylphon Company and used in Seaboard Air Line Car No. 6214 consisted of one operating switch which could be turned to any one of four positions, namely, *heat—off—vent—cool.* The schematic wiring diagram of this arrangement is shown in Fig. 1. This original panel was



Switch Pos.	Circuit Closed									
	1	2	3	4	5	6	7	8	9	10
On	•	•	•					•		•
Off				•		•	•			

Fig. 1—Schematic wiring diagram for the original form of control panel



Switch Pos.	Circuit																			
	Open										Closed									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
Cool					●						●	●	●	●		●	●	●	●	●
Vent					●				●	●	●	●	●	●		●	●	●		
Off	●	●	●	●				●	●	●					●	●	●			
Heat					●	●	●	●		●		●	●					●		●

Fig. 2—Schematic wiring diagram for the simplified control panel

modified by the manufacturer to have only two positions, *off—on*, as shown by the schematic wiring diagram Fig. 2. Since the middle of the 1943-44 winter, Car No. 6214 has been equipped with this simplified panel. Now the train crew simply turn to the *on* position at the start of the trip and to the *off* position at the destination. Four thermostats located in the inlet air duct (shown as fresh-air tubes in Fig. 1) automatically determine whether the car is set up for heating, cooling or ventilation.

The *off* position sets the car up for a parking temperature of 60 deg. F., or any other desired temperature. The compressor and blower fan circuits are open. The overhead heat valve is closed and one-half of the floor heat system is under control of the 60 deg. F. thermostat.

With the switch in the *on* position, if the outside temperature is above 60 deg. F., cooling is obtainable provided the car temperature is above the 74 deg. F. setting of the cooling thermostat located in the recirculated air stream. The car is under the control of the cooling thermostat just as it was previously when the switch was in the *cool* position. The cooling thermostat may be either the differential- or fixed-temperature type of control.

When the outside air is below 58 deg. F., but above 40 deg. F., only the overhead heat supply is available and the car is under the control of the two thermal bulbs that are part of the modulating differential overhead heat control valve. Usually this valve tends to maintain a recirculated air temperature of 73 deg. F.; though it may be adjusted to any other desired temperature. When the recirculated air temperature is, for example, 73 deg. F., the discharge air temperature from the overhead heat coil is controlled at 73 deg. F. to establish a balance of the heat input to the car; but when the recirculated air drops to 72 deg. F., the discharge air temperature rises to 75 deg. F. to restore quickly the control temperature to 73 deg. F.

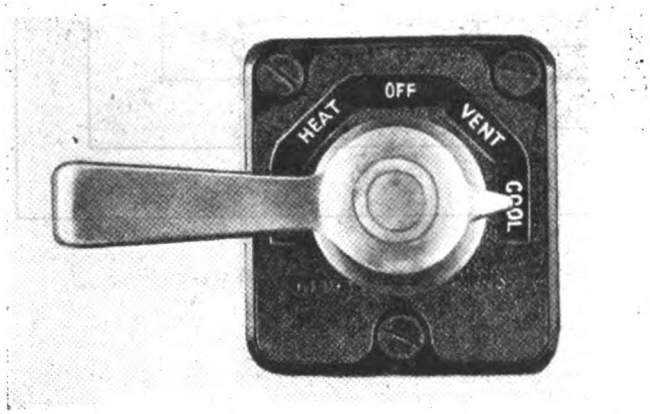
Between 40 deg. F. and 30 deg. F., the overhead heat supply and one-half of the floor heat supply is available

to maintain the car temperature at some value such as 73 deg. F. The overhead heat supply is under control of the thermostat described above and one-half of the total floor heat supply is under control of a 70 deg. F. thermostat tube located in the floor heat thermostat assembly. The available one-half of the floor heat surface will therefore not be used unless the floor heat thermostat is below 70 deg. F.

Below 30 deg. F. the overhead heat supply and the entire floor heat supply is available. The second one-half of the floor heat surface is under control of a 68 deg. F. thermostat tube located in the floor thermostat assembly and this portion of the floor heat will not be used until the temperature at the floor thermostat is below 68 deg. F.

Fig. 4 is a graph showing the results of a test run between New York City and Jacksonville, Fla. On this trip the outside air temperature varied from 44 deg. F. to 79 deg. F. and the recirculated air temperature was constant at 73 deg. F. for all the readings taken on the trip. The car started out set up for cooling and during the night the heat from the overhead heat supply became available, then in the morning the car was back to the cooling set up—all of this without any attention by the train crew.

There is a third position of the switch that is accessible by the use of a key carried by authorized persons. The purpose of this position is to permit testing of the cooling system regardless of the car temperature. In this position the cooling thermostats and cooling relay are shunted out and the compressor runs continuously under the high-low pressure control. Since all failures of any equipment will overheat the car, this one emergency position takes care of practically all emergencies. In nine months of operation, it has not been necessary to use this emergency position.



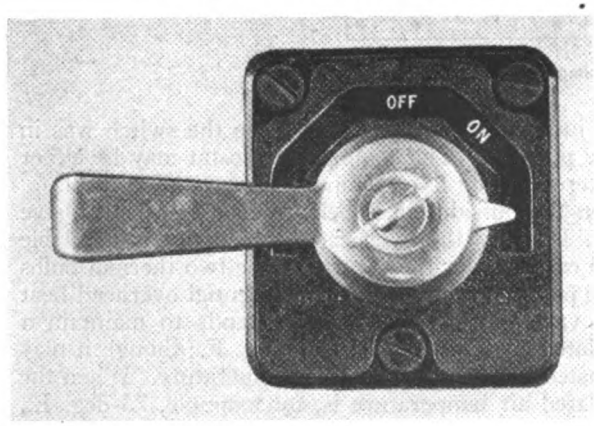


Fig. 3—Above: Control switch used on the original panel—Below: Control switch for the simplified panel

The Seaboard Air Line, because of its north and south travel, frequently encounters conditions where the train crew should operate the control switch several times during one trip. It is probable, however, that railroads operating east and west encounter similar conditions for at least several weeks during the spring and again in the fall of the year, so the simplicity of the system described in this discussion may be pertinent for other railroads.

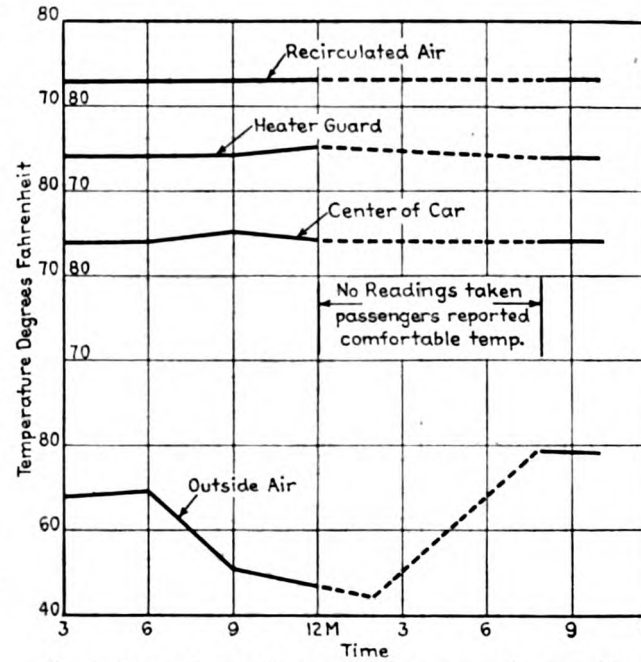


Fig. 4—Curve showing the results of a test run between New York City and Jacksonville, Fla.

The simplified selector control panel described above can also be used in conjunction with modulated or stepped cooling control systems, which are now in operation on several railroads.

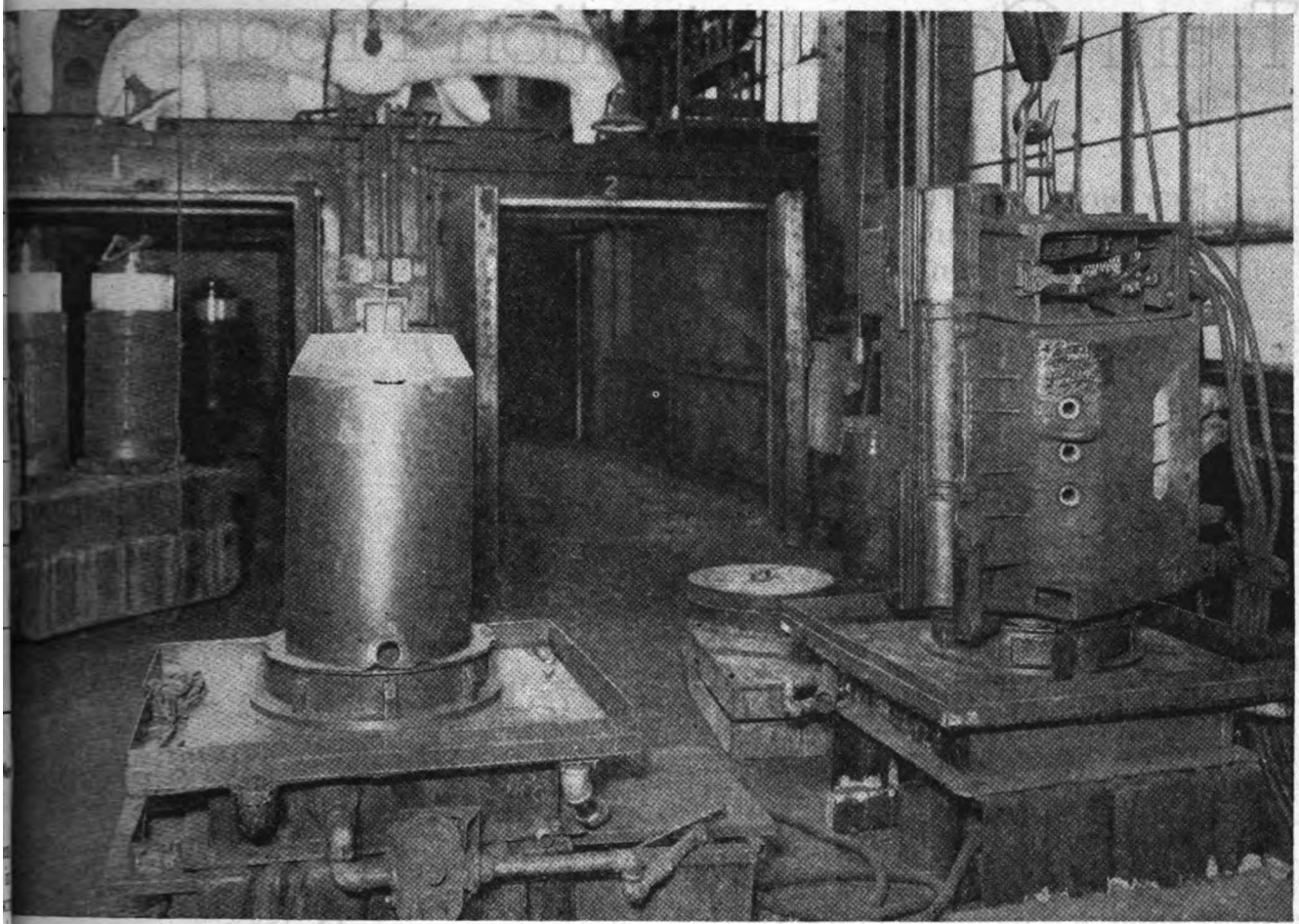
In-Place Dipping and Baking*

The dipping and baking of field coils, both main and commutating, without removal from the motor frame, presents many difficulties. To dip the whole shell means that a great deal of time must be spent with cleaning the exterior as well as the interior, and the New York City Transit System has found a means of eliminating this part of the job by the design of the fixture shown in the illustration.

The shell is dropped down on a rubber seal at the bottom, one or two small drain holes plugged, and then insulating varnish is pumped into the motor frame, flooding the entire interior including all fields. The center drum is used merely to reduce the quantity of insulating varnish required.

After the varnish has had a chance to saturate thoroughly the fields and interior of the frame, a valve at the bottom of the tank is opened and the varnish permitted to drain back into the reservoir. Pole faces are cleaned and the shells are then placed in the ovens shown directly behind those two fixtures and baked at temperatures somewhat lower than usually employed for arma-

* Abstract of a paper by B. F. Cordts, engineer, cars and shops, New York City Transit System, presented at a meeting of the Transportation Group, A. I. E. E., New York, on November 14, 1944.



Two insulating varnish impregnating stands for motor field coils—The one at the left shows the center drum used to reduce the amount of varnish required, and the one at the right shows a motor frame in place

tures to avoid damage to the motor leads which are left connected when this method is used.

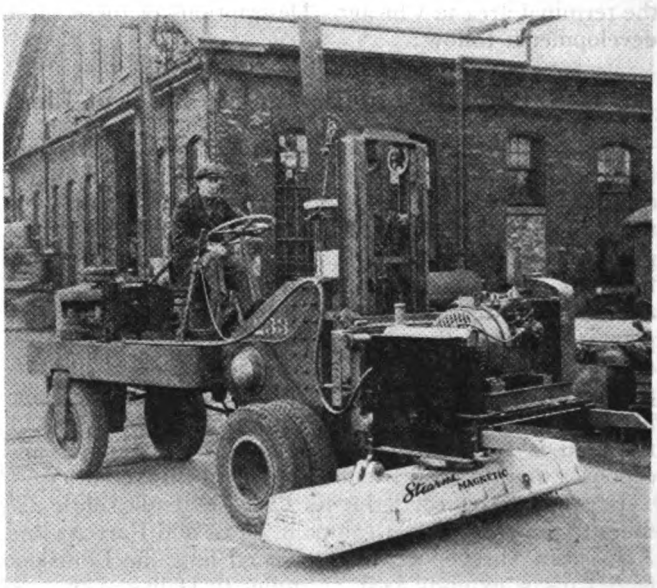
The ovens are thermostatically controlled with timers arranged to apply or cut off power for any predetermined periods. Ventilation is also controlled so that any degree of recirculation can be obtained.

Magnet Sweeps Shop Streets

A sweeping magnet portably mounted on a tiering truck is now being used over the miles of streets of the Milwaukee, Wis., shops of the Chicago, Milwaukee, St. Paul and Pacific and is collecting a surprising amount of tramp iron that would damage tires on trucks, automobiles and other vehicles which move materials from building to building. The use of the magnet was initiated by J. V. Miller, manager of stores, who conceived the idea of making the magnet and its power supply easily mountable so that it would not tie up the vehicle to which it is attached, allowing it to be used for other purposes when the streets are not being swept.

The adaptation of the magnet to the vehicle, which is known locally as the doodle-bug, was made by Paul O. Metzelfeld, supervisor of automotive equipment, under the direction of G. A. J. Carr. The engine-driven generator which supplies the power is mounted on skids and is picked up by the vehicle in the same manner that is used for handling freight. The magnet is attached with special hooks and secured with holding clamps. The operating switch shown at the right of the operator is clamped to the generator when the unit is not in use. Similar vehicles are located at other points and when necessary the generator, magnet and switch can be shipped for use at other locations.

The magnet was furnished by Stearns Magnetic Mfg. Co., Milwaukee, Wis.



Street sweeping magnet in use in the Milwaukee shops

Train Communication Progress

New orders placed and the extent of experiments made indicate that train telephones will become a regular part of operating equipment

A SUMMARY of developments in train communication was published in the August, 1944, issue of *Railway Mechanical Engineer*. Since that time, various comments have appeared, describing successively the following installations: The Pennsylvania contracted with the Union Switch & Signal Company to install inductive communication on two main-line four-track divisions covering 245 miles of line between Harrisburg, Pa. and Pittsburgh. The Federal Communications Commission held hearings in Washington, D. C., first, to establish reasons for allocating radio channels to railroads for train communication and other needs, and second, to determine exactly what channels should be allocated to railroad service. The Canadian National tried out radio telephone communication for yard operation, using 50 watt transmitters employing a frequency of 38.6 megacycles. The New York, New Haven & Hartford, in cooperation with the Westinghouse Electric & Manufacturing Company, initiated a series of tests on radio telephone train communication. A 90-mile test run featuring end-to-end train communication was made in France, using two 4-lb. Walkie Talkie sets operated from the C. B. S. Signal Section.

Other recently developed information on train communication, which has not appeared previously in these pages, includes the plans of the Kansas City Southern to install train communication on 560 miles of line between Kansas City, Mo., and Shreveport, La., the Atlantic Coast Line installation to cover 234 miles of line between Rocky Mount, N. C. and Florence, S. C., and recent tests made by the Chicago, Burlington & Quincy in the terminal area in Chicago. Descriptions of these three developments follow:

Map showing location of wayside stations between Kansas City and Shreveport to be equipped for communication with trains

K. C. S. Plans Installation on 550 Miles of Line

Subject to obtaining priorities from the War Production Board and permission from the Federal Communications Commission, the Kansas City Southern has entered into an agreement with Aircraft Accessories Corporation, Kansas City, Mo., to purchase 22 wayside-station sets and enough mobile sets for use on locomotives and cabooses to operate four trains continuously. The plan is to install the wayside sets at the stations shown on the accompanying map on the 560 miles of line between Kansas City, and Shreveport, La. After the benefits of these initial installations have been demonstrated, the plan is to equip the remainder of locomotives and cabooses used in road freight service on this territory.

Beyond Shreveport, the K. C. S. extends south 228 miles to the gulf ports, Beaumont, Tex., and Port Arthur. Also from Shreveport the associated line, the Louisiana & Arkansas, extends west 222 miles to Dallas, Tex., and southeast 312 miles to New Orleans, La. The traffic to and from these three lines is handled over one single-track line between Shreveport and Kansas City, and, therefore, the train communication is planned for this territory first as an aid in increasing track capacity and expediting train movements.

Although telephone apparatus is in service for transmission of train orders on the lines between Shreveport and Port Arthur, the Morse telegraph is still used for train orders north of Shreveport. This is an additional reason for applying the telephone train communication system on the Kansas City-Shreveport territory first, because the system supplies an additional circuit for two-way telephone conversation, by carrier, between the dispatcher's office and the principal stations on the line.

The communication system is of the carrier induction type in which the previously existing wires on the pole line are used also to "carry" the train communication energy which is at 170 kilocycles carrier frequency, using narrow band frequency modulation with unity deviation ratio.

(Continued on next left-hand page)

7 TESTS

that control all member companies' CHILLED CAR WHEELS . . . wherever they are made

THE 7 RIGID TESTS THAT GUARANTEE UNIFORMITY

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All member companies of the Association of Manufacturers of Chilled Car Wheels have their output rigidly tested by Association inspectors. In this manner, the approval of all Chilled Car Wheels is up to impartial resident examiners who release the product only if it meets all of the specifications established as standard for the industry. All this — decidedly unusual in *any* association — is done for the protection of the American Railroads. Thus, a good wheel is standardized wherever it may be made or bought.

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Ordinarily the pole line is about 50 ft. from the track, and where the ground is practically level, the line wires are about 15 to 20 ft. above the level of the rails. In rough mountainous terrain in Arkansas, the pole line may be as much as 100 ft. distance from the track, and the line wires may be 50 ft. or more above or below the level of the tracks. The train communication equipment is designed to operate satisfactorily with the line wires up to 200 ft. distance, and 50 ft. above or below the level of the track.

The antenna on the locomotive consists of 12 turns of wire, 4 ft. high and 6 ft. long in a vertical plane, with the greater dimension in the direction of travel. On the caboose, the antenna consists of four turns of wire encircling the outside of the car in the direction of travel.

When transmitting from a mobile unit as, for example, the locomotive of a train, 170-kilocycle energy is applied to the antenna to create a magnetic field which cuts or links with the line wires on the pole line, thereby inducing in the wayside wires the 170-kilocycle energy which is carried along the wires to be picked up by the antenna on the caboose. In this operation the gap between the wires of the pole line and the mobile units is bridged inductively in two instances, and these losses, together with the slight loss along the wires, requires up to 50 watts output for a range of up to 10 miles when transmitting from one train to another train, or from head to rear end of one train.

When transmitting from a wayside office to a locomotive or caboose there is only one gap between the pole line wires and the antenna on the vehicles to be bridged inductively, and therefore only 3 to 6 watts power output is required at the wayside stations for communication with locomotives or cabooses on moving trains up to a maximum distance of 25 miles under adverse weather conditions.

The wayside offices should be spaced not more than 40 to 50 miles apart, thereby making the maximum distance from a mobile unit to a wayside office 20 to 25 miles. The 20 offices on the 560 miles between Kansas City and Shreveport are at the towns shown on the map. The dispatcher at Pittsburg, Kan., handles the 236-mile territory between Kansas City and Watts, Okla. The dispatcher at Heavener, Okla., handles the 197 miles between Watts, Ark., and DeQueen, and the dispatcher at Shreveport handles the 125 miles between DeQueen and Shreveport, in addition to 110 miles beyond.

In this two-way telephone train communication system, the sets of electronic apparatus on the locomotives, cabooses and at wayside stations each include sending as well as receiving equipment designed to operate at 170 kilocycles. The receiver has a sensitivity of approximately 100 microvolts and an audio output of 1 watt (6 watts in mobile equipment). All equipment is designed for frequency modulation with a deviation ratio of unity. The audio response is practically uniform from 200 to 3,000 cycles. The transmitter, also frequency modulated, is the oscillator-amplifier type. The sending and receiving sets for use on the locomotives and cabooses are similar to those used at wayside stations except for shock mounting and for the power output rating.

On the locomotives and cabooses, as well as at the wayside stations, the receiver apparatus is normally in operation and is connected to a loudspeaker, which in effect is used only as a calling device. A hand-set, combining transmitter and receiver, is normally hung on a hook-switch. If the conductor in the caboose, for example, hears a call for him coming in on the loudspeaker he removes his hand-set from the hook-switch. This cuts out the loudspeaker and cuts in the receiver on the hand-set. When he is ready to talk, he operates a small push button on the hand-set which cuts in the transmitter and cuts out the receiver in his hand-set. In order to minimize the confusion, the volume control on the loudspeakers in the cabooses and on the locomotives is adjusted to bring in calls only from the nearest wayside stations.

It is not the intention of the railroad to use the proposed train communication system to change the present practices for authorizing train movements. On the other hand, the new communication will provide supplemental information which, in the opinion of the management, will minimize train delays in numerous instances on each trip, and thus get the trains over the road in less over-all time between terminals, thereby improving service to the public and increasing the efficiency of existing track facilities, cars and locomotives, as well as reducing overtime.

Considering the Kansas City Southern and the Louisiana & Arkansas Lines as a whole, the management estimates that a complete installation, including 65 wayside offices and 270 mobile units, would cost about $500,000. Maintenance, replacements, depreciation and obsolescence is figured as 20 per cent of the original cost annually, so that there would be an annual charge of about $100,000, which would easily be justified by the benefits of the train communication.

In 1943 the railroad paid $1,780,000 for per diem hire of freight cars, and over $500,000 for overtime and constructive allowances to freight train crews, totaling $2,280,000 of which the $100,000 is less than 5 per cent. The management is of the opinion that, by minimizing long delays on extra freight trains, the expenditures mentioned above can be reduced more than $100,000 annually.

234 Miles of Train Communication for the Coast Line

The Atlantic Coast Line has ordered from the Union Switch & Signal Co., Swissvale, Pa., inductive type train communication equipment for six wayside fixed stations and 45 mobile units sufficient to equip all regularly scheduled freight and passenger trains operating over approximately 234 miles of Coast Line system between Rocky Mount, N. C., and Florence, S. C., via Wilmington, N. C., as well as switching locomotives operating over approximately 38 miles of track in South Rocky Mount freight yards.

The line to be equipped comprises a portion of the double-track line from Rocky Mount, N. C., to Contentnea, the important single-track line from Contentnea to Pee Dee, S. C., via Wilmington, and another portion of the double-track main line from Pee Dee to Florence. This line represents an important segment of the Coast Line system, serving military installations at Goldsboro (Seymour Johnson Field), Wilmington (Blumenthal Field and Fort Fisher), Holly Ridge (Camp Davis), and Jacksonville (Camp LaJuene), as well as shipyards and war industries at Wilmington.

In making the announcement of the project, C. McD. Davis, president of the railroad, said, "It is being undertaken to determine the extent to which electronic train communication can increase efficiency of freight and passenger-train operation and supplement existing safety measures, particularly on those portions of the double-track main line included in the installation which are now equipped with automatic block signals and automatic train control. Such increased efficiency of operation will result in expediting movement of military and essential civilian freight and passenger traffic. Subject to the approval of the War Production Board and such approval of Interstate Commerce Commission as may be required,

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To meet war traffic demands

Akron, Canton & Youngstown

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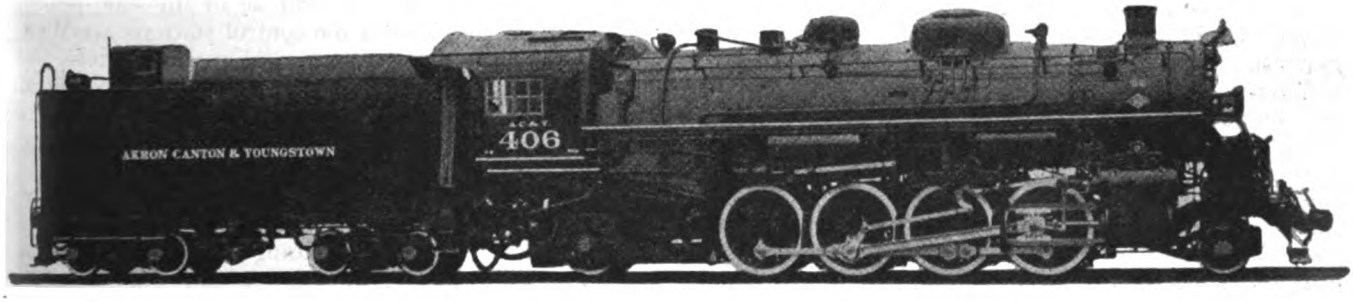
LIMA 2-8-2



Serving busy war industry centers in northern Ohio, the A. C. & Y. requires steam motive power capable of moving heavy traffic at high speeds. For this purpose it is utilizing Lima 2-8-2's, and has just added another of these Super-Power Locomotives to its fleet.

LIMA LOCOMOTIVE WORKS — LIMA LOCOMOTIVE WORKS INCORPORATED — INCORPORATED, LIMA, OHIO

Radio equipment in the cab of a Burlington locomotive—Sending and receiving equipment is enclosed in the box marked X

the equipment will be installed as quickly as received from the manufacturer."

Burlington Uses Radio to Direct Switching

A test installation of high-frequency radio has been in service on the Chicago, Burlington & Quincy, since October 28, for two-way telephone service between three Diesel-electric switching locomotives and three offices in the Chicago area. The offices are those of the assistant superintendent at Fourteenth street, the yardmaster at Western avenue, 3.5 mi. west of the Fourteenth street office, and the trainmaster at Morton Park yard, 5 mi. west of Western avenue.

The three radio equipped locomotives are being used to deliver cars to various freight houses, team tracks and industries, as well as to pick up cars at these locations and return them to freight yards. In this service, the switching locomotives are working, for periods of several hours at a time, at points remote from open offices of the railroad. The radio telephone between these locomotives and the three offices has improved switching service to shippers and has increased the utilization of the locomotives. Based on these results, Ralph Budd, president, has directed that as soon as authority and wave length assignments are issued by the Federal Communications Commission, radio communication be installed permanently on a major proportion of Burlington switching locomotives in service in the Chicago area and elsewhere in certain large yards.

These tests in the Chicago switching district follow a preliminary test made on June 15, between a yard office and an instruction car operated between Chicago and Downers Grove, Ill., a distance of 20 mi., and others made between the head-end and rear-end of freight trains operated between Chicago and Denver, Colo., and between Chicago and Kansas City, Mo., during the period from July 1 to September 30.

The radio unit, which sends all messages from three remote offices to the three locomotives, and receives all communications from the locomotives, is located on the fifth floor of a warehouse at Fourteenth street. The units on the three locomotives are located in the cabs. The four units, which were furnished by the Radio Division of the Bendix Aviation Corporation, are V. H. F. type employing amplitude modulation and operating at a frequency of 156.525 megacycles. The input to each unit is 21 watts and the maximum output is 10 watts. The power supply for the fixed unit is public service 110-volt 60-cycle a.c. rectified to the necessary plate and filament energy required by the receivers and transmitters. The power supply for each mobile unit is a 28-volt motor-generator set, fed by the batteries of the locomotive.

The antenna at Fourteenth street, a ½-wave dipole type, is mounted on a 36-ft. steel pole located on the roof of the building at Fourteenth street, or 129 ft. above the ground. It is fed with a coaxial cable extending from the transmitter on the fifth floor. It is a directional beam type, having one reflector and two directors parasitically excited. Because of its location and the ability of the beam to fan out into a cone with a diameter of 15 mi. at a distance of 20 mi., the output of the transmitter is confined to the area in which the locomotives are operated with a resulting strengthening of signals.

The antennae on the locomotives are 36 in. tall and are located 12 ft. from the top of the rail on the front end so that the metal cab will not act as a reflector. They are ½-wave vertical types with a ¼-wave horizontal matching stub. They are fed with coaxial cables.

The unit at Fourteenth street is connected by wire to three remote-control points including the office of the assistant superintendent of the Chicago division, which is located on the first floor of the warehouse containing the radio unit; the office of the yardmaster at Western avenue, 3½ mi. west of the radio units; and the office of the trainmaster at Morton Park, 8½ mi. southwest of the radio unit.

Each of these offices contains a relay switch, a loudspeaker and its amplifying unit and a standard cradle-type telephone set containing a microphone and a receiver. All instruments are connected to the wires from the radio unit at Fourteenth street through the relay switch. This switch activates a relay on the radio unit which throws either the transmitter or the receiver of the unit in circuit with the head set or the loudspeaker. The three microphones at the control stations are Westinghouse Electric & Mfg. Company F-1 transmitters. All loudspeakers are in circuit during idle time so that all can receive calls from the locomotives and other stations. The same equipment and circuits are used in the cabs except that electric-dynamic microphones are employed.

The tests which have been carried on thus far, have been confined to a 15-mi. area but communication has been maintained as far as LaGrange, a distance of 20 mi. They have shown possibilities for speeding up operations by a direct and continuous contact between locomotives and trainmasters and yardmasters.

Increased efficiency of operations resulting from the use of radio is due to the constant contact with the locomotives. Without radio, the only contact while the locomotive is away from its terminal is through the yardmaster, who has to search for the locomotive or through industries which can be prevailed upon in emergencies, to call the engine foreman to the telephone. When radio is employed, the location of and the work being performed by the locomotive can be determined in a few seconds and the engine foreman directed to perform a pick-up at an industry or some other switching operation in the immediate territory.

Sodium Lights Reduce Accidents

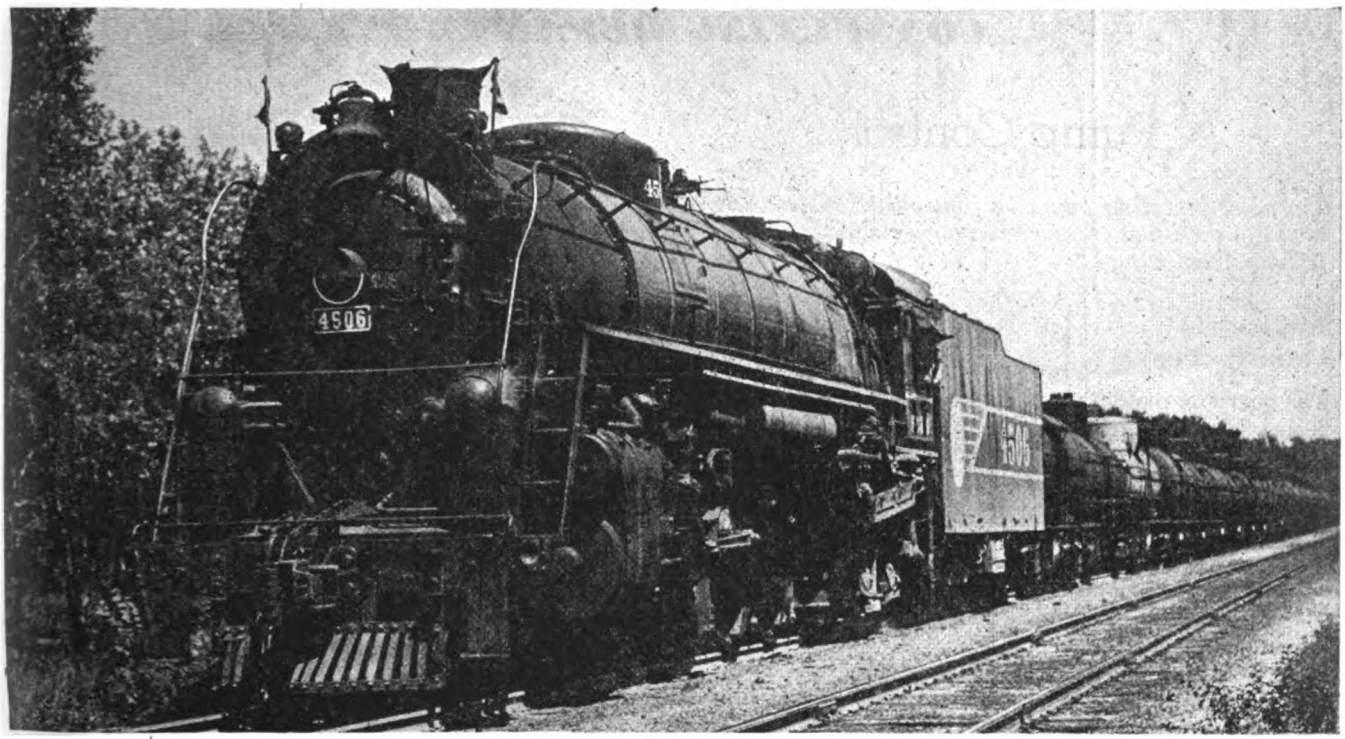
The installation of sodium luminaries at twelve grade crossings within the city of Niagara Falls, N. Y., has resulted in an outstanding reduction in night traffic accidents, according to a recent announcement by T. P. Redding, general superintendent of the Niagara Junction Railway Company.

The company, a terminal switching railroad, has 38

(Continued on next left-hand page)

Increased Capacity

FOR FRISCO FASTER FREIGHT 4-8-4's



Franklin Type "E" Locomotive Boosters*

used in both Freight and Passenger Service

Heavy freight and passenger traffic moves fast on the FRISCO, because its 4500 Class 4-8-4 locomotives, used in both kinds of service, have Franklin Type E Boosters.

The Booster saves starting time by providing quicker pick-up. It enables the locomotive to accelerate rapidly to road speed and maintain speed on grades.

By making it possible to haul heavier trains at sustained speeds, it helps to increase the traffic capacity of any line.

These advantages can be secured by any railroad through the application of Franklin Type E Boosters to its locomotives.

*Trade Mark Reg. U.S. Pat Off.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO

In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

miles of track within the city limits. During the four and one-half years prior to lighting, night accidents at nine city and four private grade crossings averaged six a year. In the seven years since the crossings were lighted, this average has dropped to 1.3 a year—despite the fact that train movement has doubled since the start of the war.

Two General Electric Novalux sodium luminaries are used at each crossing, but the yellow light, the company has found, serves as a much stronger caution measure than the flashlight signals alone.

"Our difficulty," said Mr. Redding, "used to be with automobiles running into the side of the train. Motorists had a tendency to ignore the flashlight signals, presumably in the belief that no train was approaching. Since the crossings were not illuminated, freight cars preceding the engine were not visible. Now motorists can easily see approaching trains, which travel over the crossings at a very low rate of speed.

"Our experience with this yellow caution light has been so satisfactory that I would like to see it used universally on highway grade crossings. In fact, I would rather do without the flasher signals than without sodium vapor lights."

CONSULTING DEPARTMENT

Pump Control

Can a reciprocating pump be controlled satisfactorily by means of the usual pressure-responsive devices often used on centrifugal pumps?

Answer is Usually Yes

The query on motor control is too indefinite for a positive reply. However, it is possible to give several yes and no answers. A number of reputable manufacturers make crank-driven pumps which are controlled by pressure-actuating switches. It would appear, therefore, that the answer is yes. In the case of some steam-driven, direct-connected pumps, the answer should be either yes or no, but there would be no advantage in using electric control since a regular steam pressure regulating valve would give better service.

If electrical control of the steam supply of a steam-driven pump were in question, my opinion is that a steam pump governor would be more satisfactory. It is seldom that a steam-driven reciprocating pump needs to come to a complete stop as leaks in the system, or pump, or a low demand for service will allow some movement of the pump. Within reason, this is an advantage since the pump will not lose its suction, the steam cylinder is kept warm and more or less clear of condensation, and the pump governor does not require being kept in perfect repair, and the drop in pressure when large demands for service are met is within practical range. Therefore, if steam is available and is preferred, there is no practical reason for using a more costly and less reliable method of electrical control of that steam supply, and this fact is recognized as electrical controls are mostly confined merely to making and breaking contacts in a power circuit, even though other items are required to make the system, as a whole, operate.

In a general way, the answer could be determined by the following conditions: the starting load must be below the capacity of the circuit breakers, or fuses used, and the motor must attain full speed before the pumping action of the pump plungers can build up the hydraulic pressure. However, if more than one such installation is used and there is a likelihood of simultaneous starting of two or more pumps, the total load of all pumps must be added to such other load as is ordinarily carried.

Another point is that pressure relay switches have a range of from 10 to 15 lb. between the kick-in and the kick-out adjustments. While it is possible to set the two

Can you answer the following question? Answers should be addressed: Electrical Editor, *Railway Mechanical Engineer*, 30 Church Street, New York 7.

We are planning to rebuild our secondary distribution lines consisting of three-phase, 440 volts, for power and 110-220 volt three-wire, single-phase for lighting. Which would be most economical and efficient over a period of years: secondary racks or cross-arms and pins?

●

rather close together, such adjustment causes rapid starting and stopping, commonly known as cycling, to occur, resulting in rapid wearing out of the relay and heavy power consumption.

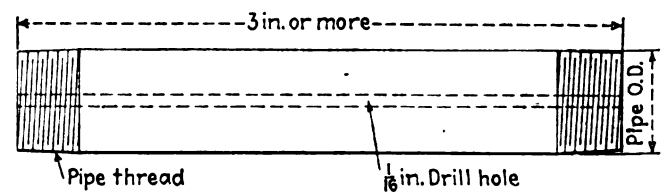
By placing an expansion tank between the line and the pressure-operated valve, the cycling can usually be avoided, though in some instances it may be necessary to use a small orifice between the line and the tank. In this way satisfactory operation usually may be obtained.

LINWOOD SKELLENGER

Drill Rod Found Effective

As a general rule, we have found that the duty on the control system is more severe with direct acting pumps than with the centrifugal pumps. So much depends on the length of the pipe line to which they are connected that it is almost impossible to give a general statement.

One trick we have worked out may be of interest.



Drill rod with pipe threads at each end which is placed between the air chamber and the control mechanism

Instead of trying to use needle valves or orifice plates, we take a piece of cold rolled steel rod having the same outside diameter as a ¼-in. or ⅜-in. pipe, cut a pipe thread on each end and then drill a 1/16-in. hole. If this choke or nipple is made about 3 in. long, and the air chamber connected to it and in turn to the control mechanism, this scheme does a very good job of cutting off these surges and pulsations.

JOHN M. DRABELLE

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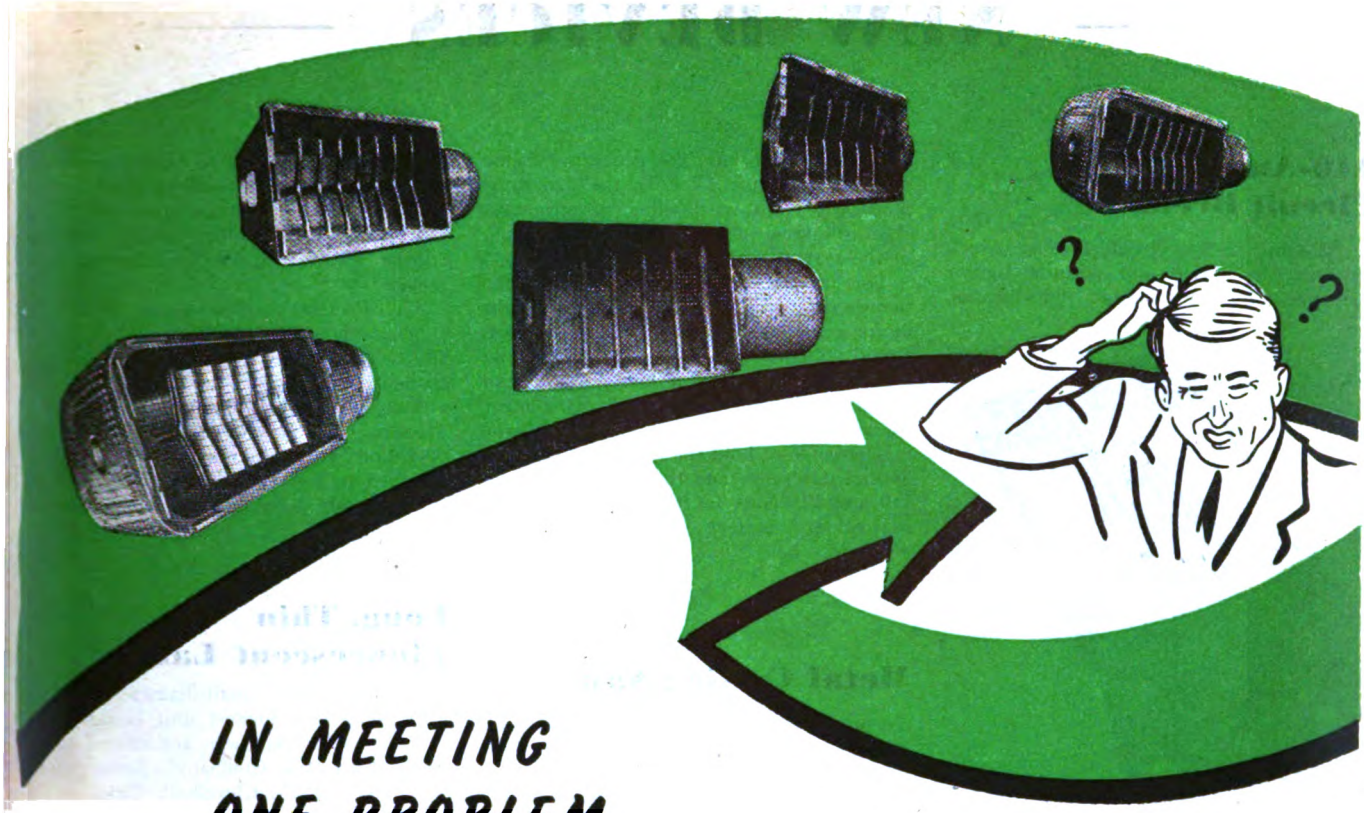


IN MEETING ONE PROBLEM

SECURITY CIRCULATORS

HAVE SOLVED SEVERAL OTHERS

THE demand for greater boiler horsepower, in the modern steam locomotive, has led to the construction of larger fireboxes. This in turn presented a problem of brick arch support, to meet which Security Circulators were primarily developed.

Security Circulators may be installed in any locomotive and permit the use, in any type of firebox, of a 100% arch, for which they provide the ideal support.

In addition to this, Security Circulators give the positive protection of a continual flow of water over the center of the crown sheet. Security Circulators also improve circulation in side water-legs.

Furthermore, Security Circulators tend to reduce honeycombing, flue plugging and cinder cutting.

AMERICAN ARCH COMPANY, INC.

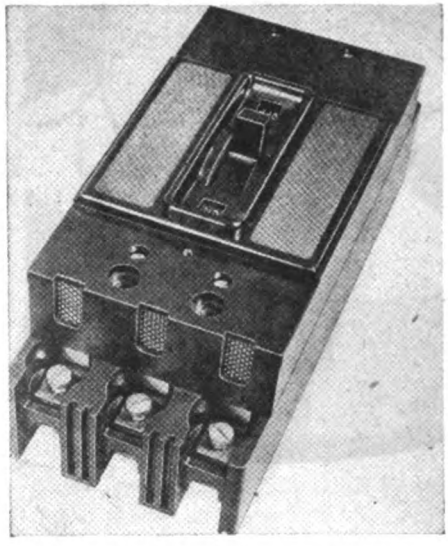
NEW YORK • CHICAGO

SECURITY CIRCULATOR DIVISION

NEW DEVICES

110-Amp. Circuit Breaker

A 100-amp. De-ion circuit breaker which requires less space and permits lighter structures for distribution panelboards,



Fuseless circuit breaker rated at 100 amp. which fits mounting space of former 50-amp. breakers

built-in applications and bus duct plug-ins is announced by Westinghouse Electric & Manufacturing Company.

All ratings are available in one compact breaker with uniform pole spacings and terminal arrangement, providing complete interchangeability between ratings. The new F frame permits for the first time a 100-amp., 600-volt a. c. or 250-volt d. c. breaker in the same space formerly required by the 50-amp., 600-volt a. c. or 250-volt d. c. rating.

Equipped with thermal and instantaneous magnetic trip elements, the fuseless circuit breaker permits maximum loading of circuits and fast resumption of interrupted service. Contact pressure increases with wear, thereby prolonging the life of contacts and breaker. Silver alloy contacts give increased contact life with lower wattage loss. The special alloys used also permit "freezing". Both two and three-pole units are available.

Power Supply For Passenger Cars

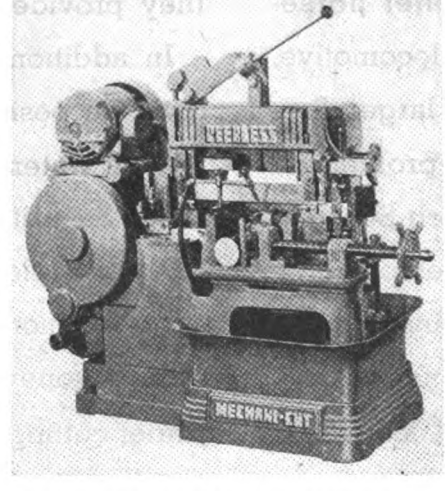
An axle-driven generator has been developed by the Westinghouse Electric & Manufacturing Company to supply the necessary power for railway passenger cars. The generator is a 76-volt machine designed to serve a 64-volt car power system. Light weight and small size are achieved in part by high speed; 4,000 r. p. m. at 120 m. p. h. Built into the generator frame is an a. c. motor to drive the generator when the train is standing in terminals. Also the separate motor permits testing of the system without moving the car.

To provide alternating current for fluorescent car lighting a new lightweight motor-generator set has been developed. Rated at 4 kw. at 3,600 r. p. m. it is no larger than the earlier 2-kw. sets that ran at half that speed. By a new arrangement of fields on the motor and the generator it is possible to hold the frequency between 58 and 62 cycles, and the voltage between 110 and 125 volts for the great variations in load and battery voltage that can be expected.

Metal Cutting Saw

To meet the need for a metal-cutting saw having full mechanical drive, four-sided saw frame performance and finger-tip control of the feed pressure, the Peerless Machine Company, Racine, Wis., has developed the new Mechani-Cut model illustrated. This saw is designed to cut at higher speeds with unusual precision and is convertible to manually operated conveyor operation right on the job. It is available in capacities of 7 in. by 7 in., 11 in. by 11 in. and 14 in. by 14 in.

A new feature of the Mechani-Cut is the compensation feed unit. A highly-sensitive rack-and-pinion feed compensates for



Peerless mechanically driven metal-cutting saw

hard spots in the work and varying shapes and types of stock. This feed unit is mounted away from falling chips and coolant spray. Pressures are set by fingertip control and are adjusted to a fraction of a pound.

A massive four-sided saw-frame surrounds the blade and the work and permits locating bearings above and below the saw-blade. Hardened and ground renewable inserts take all strain and wear as the saw frame reciprocates, giving sustained cutting accuracy at low cost for years of service.

The Peerless backing-plate, locked 1/32 in. above the saw blade, gives added rigidity and permits maximum cutting pressures without undue injury to the blade. Precision built and assembled, the Peerless Mechani-Cut promises long, continuous operation with minimum attention and is intended to meet present needs as well as being readily adaptable to post-war work.

Long, Thin Fluorescent Lamps

A line of four small-diameter fluorescent lamps, the longest unit being nearly 8 ft. in length, has been announced by the General Electric Company's lamp department, Nela Park, Cleveland, Ohio.

Also included in the new line, called Slimline Mazda fluorescent lamps, are two ¾-in. in dia. sizes, one approximately 3½ ft. long, the other slightly more than 5 ft. in length, and another 1-in. in dia. lamp approximately 6 ft. long.

All four lamps will be of the instant starting type, none of which will require starters. A feature of the new lamps is that, for the first time, hot cathode fluorescent lamps are recommended for operation at more than one wattage and current value. Each of the new lamps will have a single pin base, will be of hot cathode design, and initially will be furnished in white color only. At their present stage of development, the new slim lamps have an estimated life rating, at 200 ma. operation, equal to that of the 40-watt F lamp, namely, from 2,500 to 6,000 hr., depending on frequency of starting. Initial efficiency of the new G-E Slimline Mazda F lamps averages approximately 60 lumens per watt. This light output is considerably more than that of the standard F lamp. Current and lumen data for the new lamps is as follows:

Lamp*	Current ma.	Lumens (approx.)
42T6	100	900
	200	1,400
64T6	100	1,400
	200	2,200
72T8	100	1,500
	200	2,300
96T8	100	1,900
	200	3,000

A limited number of samples of 42T6 and 64T6 lamps for design purposes are now available and samples of 96T8 lamps will be provided as soon as manufacturing conditions permit.

* First two numerals indicate nominal length in inches. Last number designates diameter in eighths of an inch. Nominal length includes one lamp plus two multiple sockets. When series sockets are available, the increase in over-all length will be announced.

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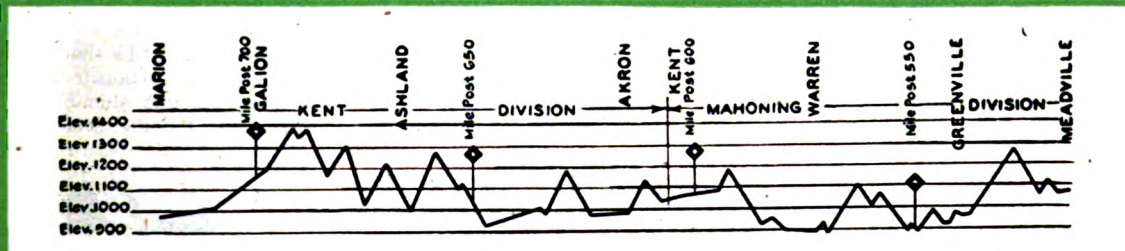
Diesels

CONQUER HEAVY GRADES

on two Erie Divisions



Six General Motors 5400 H.P. Freight locomotives have gone into service on the Erie to conquer the steep grades and to alleviate traffic bottle-necks on the Kent and Mahoning divisions. No longer will it be necessary to split eastbound freights at Marion and westbound trains at Meadville and tie them together again a few hours later. Diesel operation will mean that for the first time a solid train with full tonnage can be run from one end of the line to the other without splitting it up at intermediate terminals on account of grade changes—a big saving in time and serious traffic delays.

★ *ON TO FINAL VICTORY — BUY MORE WAR BONDS* ★

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS CORPORATION LA GRANGE, ILLINOIS, U.S.A.

NEWS

Equipment Builders May Exceed Schedules

BUILDERS of railroad cars and locomotives may produce such equipment in advance of their production schedules, after giving the War Production Board notice that conditions permit manufacture ahead of schedules, W.P.B. has announced. The authorization appeared in amendment to Orders 1-97 and L-97a effective November 25, 1944.

Subject to the condition that sequence of production established in schedules must be maintained, the manufacturer may proceed with such advance production provided it does not interfere with other schedules, it was explained, unless he is otherwise directed, in writing, by the W.P.B.

R. V. Fletcher Becomes A.A.R. Research Head

R. V. FLETCHER, vice-president of the Association of American Railroads, has been named vice-president-research.. Mr. Fletcher, who has been chairman of the Railroad Committee for the Study of Transportation since 1942, heads the new research department and will co-ordinate all research activities of the various divisions of the Association. Under the original plan of organization of the A.A.R., which provides for the creation of the research department headed by a vice-president, research activities will be divided into two divisions, technical research and economic research, and the vice-president will have the authority to employ a director of each.

Present plans of the Association provide for the completion of the study of economics by the Railroad Committee for the Study of Transportation, which has been active since 1942, rather than by the new division.

More Advance Orders Sought by Locomotive Builders

LOCOMOTIVE builders represented by the Industry Advisory Committees of the War Production Board have informed that agency that orders for new locomotives, including foreign requirements, must be placed immediately if full advantage is to be taken of available manufacturing capacity. Present W.P.B. production schedules for large locomotives (that is, over 100 tons) are projected only through the second quarter of 1945, it was explained, and emphasis was put on the dangers in such a situation, both in loss of manpower to other industries and in delays in placing orders for and obtaining deliveries of components, such as injectors, superheaters, and feed water pumps, whose manufacturers must know the builders requirements well in advance.

Steam Turbine Locomotive for Pennsylvania

THE Pennsylvania has completed a coal-burning steam locomotive powered by a turbine in place of the customary cylinders, pistons, and driving rods. The locomotive, a 6-8-6 type, was designed and built by the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Company in collaboration with the Pennsylvania.

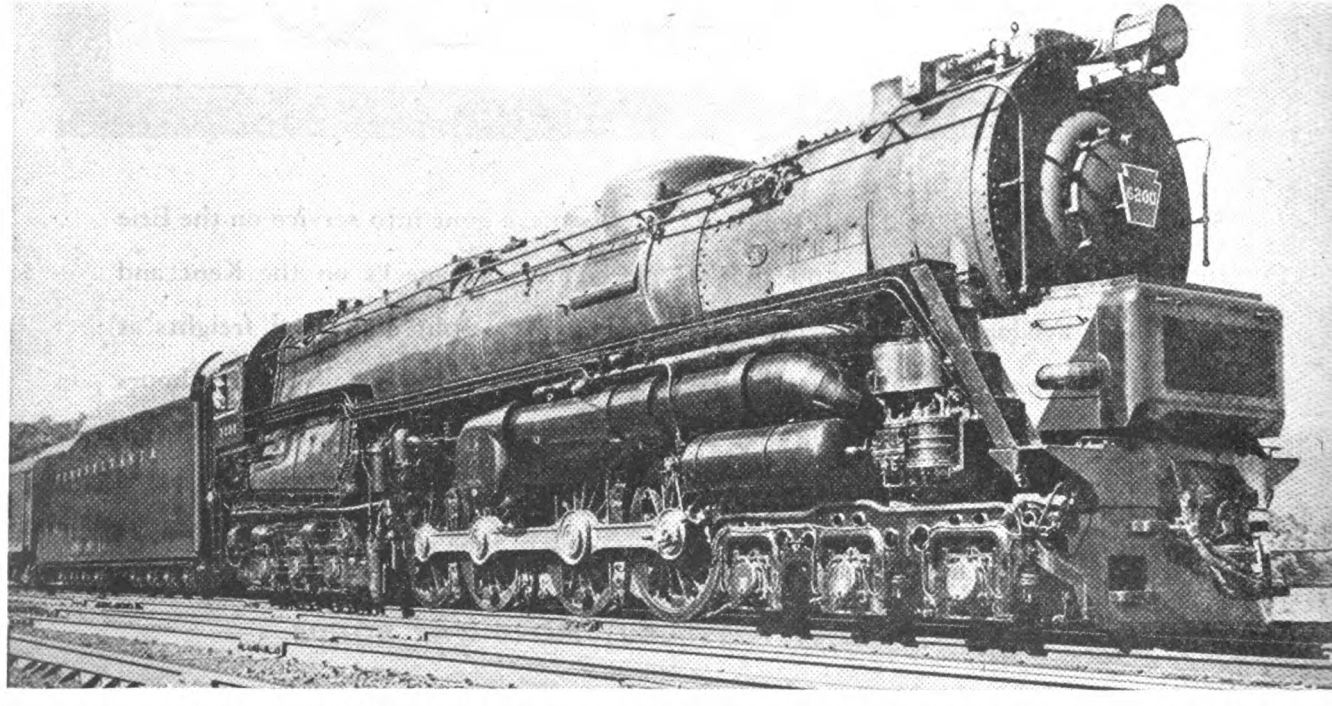
Two turbines are mounted transversely between the No. 2 and No. 3 pairs of driving wheels, both of which are quill-driven through reduction gearing. The main turbine for forward motion, on the right-hand side, is 3 ft. 9 in. in diameter and is always in gear. The smaller, backward-motion turbine, mounted on the left side, is brought into operation by engaging a clutch. The horsepower rating of the main turbine is 6,500 at 9,000 r.p.m. and is designed to develop a maximum of 6,900 shaft horsepower.

The operation of the locomotive, both in forward and backward motion, is controlled by the movement of a single lever. This operates through specially designed pneumatic control apparatus which automatically interlocks the reversing sequence so that the locomotive cannot be reversed until it has come to rest and steam cannot be admitted to the reverse turbine until the clutch is in mesh.

The total engine weight is 582,700 lb., of which 260,000 lb. are on the drivers. The driving wheels are 68 in. in diameter and the boiler pressure, 310 lb. per sq. in. The tender carries 37½ tons of coal and 18,000 gallons of water.

First Quarter Steel Allotments Include Passenger-Car Materials

MATERIALS for the construction of 105 passenger-train cars are included in allocations of 1,254,838 short tons of carbon steel and "proportionate amounts of alloy steel, copper and aluminum," which have been made for the first quarter of 1945



Pennsylvania direct-drive steam-turbine locomotive, designed and built by the Baldwin Locomotive Works and the Westinghouse Electric & Manufacturing Company in collaboration with the railroad

by the War Production Board to the Office of Defense Transportation, as claimant agency for domestic transportation under the Controlled Materials Plan. Freight car materials have been made available for the construction of "up to a maximum of 2,300 box cars," while 507,000 tons of carbon steel have been allocated for replacement rails.

The 105 passenger-train cars are "now on schedule," the O.D.T. announcement said, adding that "the balance of O.D.T.'s program of 250 cars per quarter will be started as soon as governmental authorities approve the manpower requirements." The 105 will be "chiefly day-coaches, with some baggage, mail and express cars."

The allocations for the 2,300 box cars were contingent upon the placement of orders by the railroads with car builders by December 1.

Meanwhile carbon-steel requirements for locomotives were also met "with amounts sufficient to cover production schedules."

In addition to the direct allocations, the W.P.B. set aside what the O.D.T. announcement called "an adequate reserve for railroad and local transit maintenance, repair and operating supplies."

Cornell Becomes Director of W.P.B. Equipment Division

GEORGE M. CORNELL, deputy director of the Transportation Equipment Division, War Production Board, has been appointed director of the division, succeeding C. B. Bryant. Mr. Bryant returned on November 18 to the Southern where he is assistant to vice-president, in charge of research and tests. He had been on leave of absence since July 1 for the W.P.B. assignment.

Officers of A. S. M. E. Railroad Division for 1945

DURING the annual meeting of the American Society of Mechanical Engineers, held at the Hotel Pennsylvania, New York, a joint session of the Railroad Division and the Oil and Gas Power Division was held on November 29 at which the subject of discussion was the gas-turbine locomotives. Two sessions of the Railroad Division were held on November 30 on locomotive and car subjects, at which the chairman of the Railroad Division, John G. Adair, mechanical engineer, Bureau of Locomotive Inspection, Interstate Commerce Commission, Washington, D. C., presided. At the close of the afternoon session R. M. Gates, president of the society, presented a certificate of appreciation to Mr. Adair and complimented the Railroad Division on its achievements and opportunities for further service to the railroad and railway supply industries.

Officers of the Railroad Division for 1945, including those newly appointed, are as follows: Executive Committee—Chairman, W. M. Sheehan, assistant vice-president, General Steel Castings Corporation, Eddystone, Pa.; K. F. Nystrom, mechanical assistant to vice-president, Chicago, Milwaukee, St. Paul & Pacific, Milwaukee, Wis.; W. C. Sanders, general manager, Railroad Division, Timken Roller Bearing Company, Canton, Ohio; B. S. Cain, assistant engineer, Locomotive Division, General Electric Company, Erie, Pa.; secretary, E. L. Woodward, western mechanical editor, *Railway Mechanical Engineer*. Mr. Sheehan will also serve as chairman of the General Committee on which L. B. Jones, engineer of tests, Pennsylvania, Altoona, Pa., was re-elected for another period of five years. Fred Huston, International Nickel Company, New York, was elected to fill the unexpired term of Mr. Cain who was advanced to the Executive Committee. Two additional new members of the General Committee elected for five-year terms included C. E. Pond, assistant to superintendent of motive power, Norfolk & Western, Roanoke, Va., and C. H. Beck, general sales manager, Westinghouse Air Brake Company, Wilmerding, Pa.

Orders and Inquiries for New Equipment Placed Since the Closing of the December Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Atchison, Topeka & Santa Fe	1[1]	1,000-hp. Diesel-elec.	Fairbanks, Morse & Co.
	10[2]	5,400-hp. Diesel-elec. frt.	Electro-Motive
Aroostook Valley	2	380-hp. Diesel-elec.	General Electric Co.
Canadian Pacific	30	4-6-2	Montreal Electric Wks.
	13	Diesel-elec. switch.	American Loco. Co.
Chicago & Eastern Illinois	4	1,000-hp. Diesel-elec.	American Loco. Co.
Chicago & North Western	7	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
	10	660-hp. Diesel-elec.	Baldwin Loco. Wks.
Chicago, St. Paul, Minneapolis & Omaha	2	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
	3	660-hp. Diesel-elec.	Baldwin Loco. Wks.
Detroit Terminal	2	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Kentucky & Indiana Terminal	2	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
Minneapolis & St. Louis	2	4,050-hp. Diesel-elec.	Electro-Motive
Minneapolis, St. Paul & Sault Ste. Marie	2[3]	1,000-hp. Diesel-elec.	American Loco. Co.
Pacific Great Eastern	2[4]	2-8-2	Canadian Loco. Co.
St. Louis-San Francisco	7	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
St. Louis Southwestern	7	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.
	2	5,400-hp. Diesel-elec. frt.	Electro-Motive
Southern	2	5,400-hp. Diesel-elec. frt.	Electro-Motive
	7	1,000-hp. Diesel-elec.	American Loco. Co.

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Atchison, Topeka & Santa Fe	500	50-ton auto-box	Pullman-Standard
Central of Georgia	100	50-ton pulpwood	Greenville Steel Car
Chesapeake & Ohio	990	50-ton box	Pullman-Standard
Chicago & North Western	500	70-ton hopper	Pullman-Standard
	500	70-ton hopper	General American
	750	70-ton gondola	Bethlehem Steel
	250	70-ton ballast	American Car & Fdry.
	100[5]	50-ton hopper	Mt. Vernon Car
	400[5]	50-ton box	American Car & Fdry.
Erie	500	50-ton box	American Car & Fdry.
Lehigh Valley	15	Caboose	Co. shops
Minneapolis & St. Louis	500	50-ton box	General American Trans.
Monongahela Connecting	50	120-ton gondola	Co. shops
New York Central	1,000[6]	70-ton gondola	Dispatch Shops
	2,000[7]	Box	Dispatch Shops
	2,000[7]	Box	American Car & Fdry.
New York, Chicago & St. Louis	500[8]	50-ton box	Ralston Steel Car Co.
St. Louis-San Francisco	50	70-ton hopper	Co. shops

FREIGHT-CAR INQUIRIES

Baltimore & Ohio	500	50-ton auto box
Chicago & Eastern Illinois	500	50-ton hopper
Erie	500	50-ton box
Fruit Growers Express	125	40-ton refrigerator
Great Northern	250	70-ton flat
St. Louis Southwestern	25	Covered hopper
Toledo, Peoria & Western	50	Box
Western Maryland	100	50-ton box
Western Fruit Express Co.	175	40-ton refrigerator

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Great Northern	5	Bagg.-mail	Pullman-Standard
	20	Coaches	Pullman-Standard
	5	Diners	Pullman-Standard
	5	Dormitory-coffee shop	Pullman-Standard
	15[9]	Sleeping	Pullman-Standard
	5[9]	Obs.-bedroom-lounge	Pullman-Standard
Minneapolis & St. Louis	6[10]	Coaches	Edw. G. Budd
Northern Pacific	36[11]	64-pass. coaches	Pullman-Standard
Wabash	1[12]	Bagg.-mail	American Car & Fdry.
	1[12]	Baggage	American Car & Fdry.
	1[12]	Coach	American Car & Fdry.
	1[12]	De luxe coach	American Car & Fdry.
	1[12]	Coach-buffet	American Car & Fdry.
	1[12]	Parlor-obs.	American Car & Fdry.
	1[12]	Dining	American Car & Fdry.

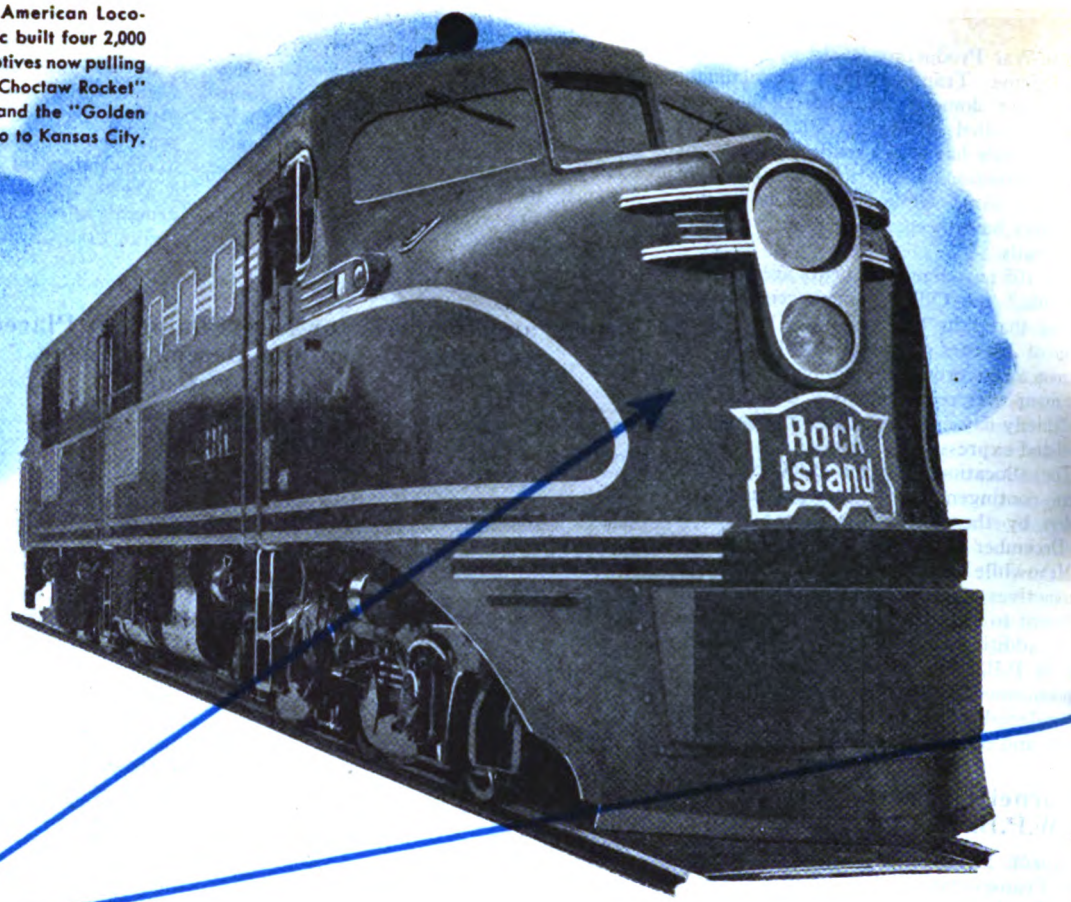
PASSENGER-CAR INQUIRIES

Canadian Pacific	10[13]	Bagg.-exp.

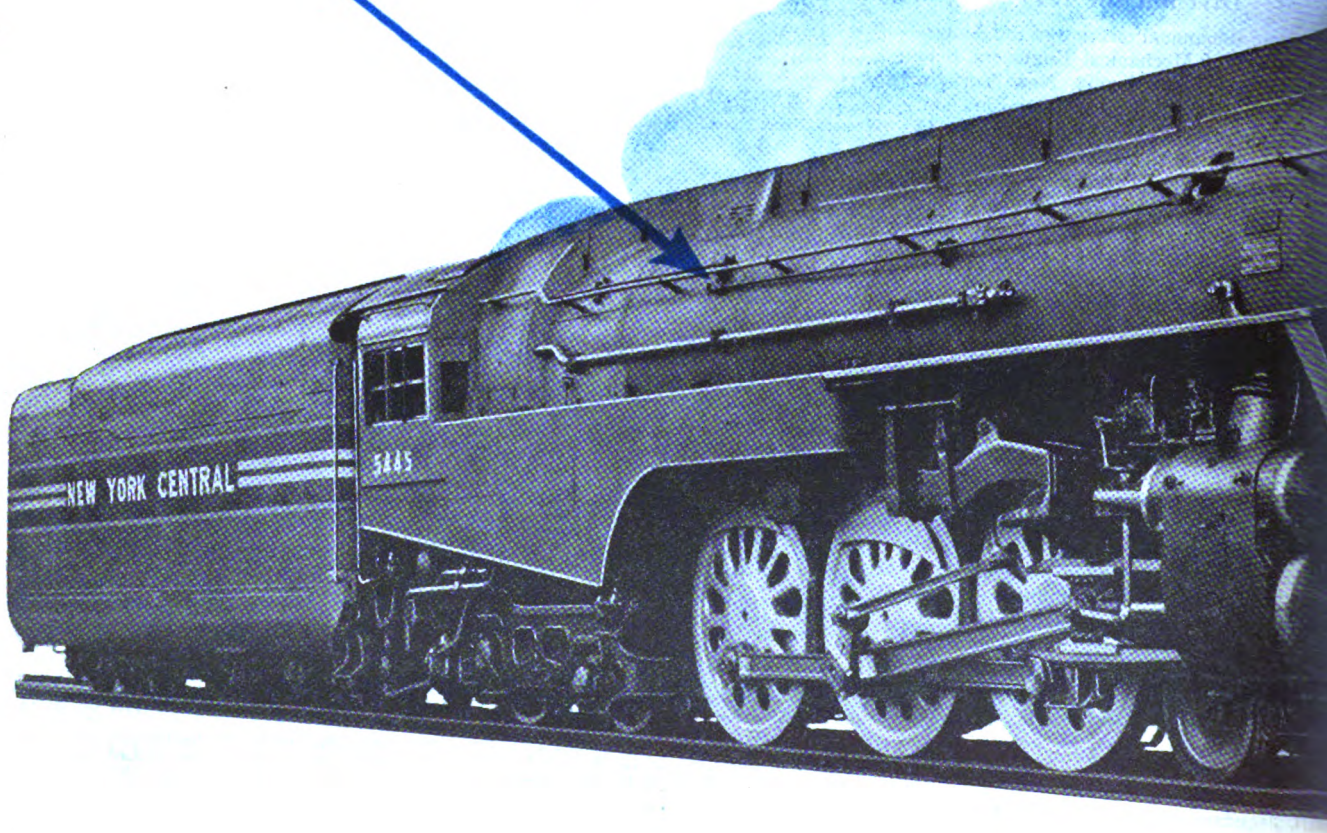
[1] For delivery in February, 1945.
[2] When these and other locomotives now on order are delivered the Santa Fe will have a fleet of 78 5,400-hp. Diesel-electric freight locomotives.
[3] For service on the Duluth, South Shore & Atlantic.
[4] For delivery in May, 1945.
[5] For Chicago, St. Paul, Minneapolis & Omaha.
[6] For the Pittsburgh & Lake Erie.
[7] The 4,000 box cars will cost $13,000,000.
[8] For delivery during second quarter of 1945.
[9] Will not be purchased if the Pullman Co. can supply the sleeping cars when the other cars are delivered.
[10] Stainless steel, air conditioned.
[11] Lightweight de luxe coaches of alloy-steel construction.
[12] For one lightweight train. A Diesel locomotive for the train has been ordered from Electro-Motive. If materials are released promptly by the W. P. B., the train, which it is estimated will cost $900,000, will be delivered late in 1945.
[13] The Canadian Pacific also has asked for bids on steel frames for 35 lightweight air-conditioned coaches and five air-conditioned roomette sleepers on which the finish will be applied at the Angus shops. Each of the roomette cars will have five double bedrooms and ten roomettes. In the daytime the enclosed roomette will be made up as a single seat with all facilities for the passenger, including baggage rack, clothes locker, ice water, toilet and wash basin.

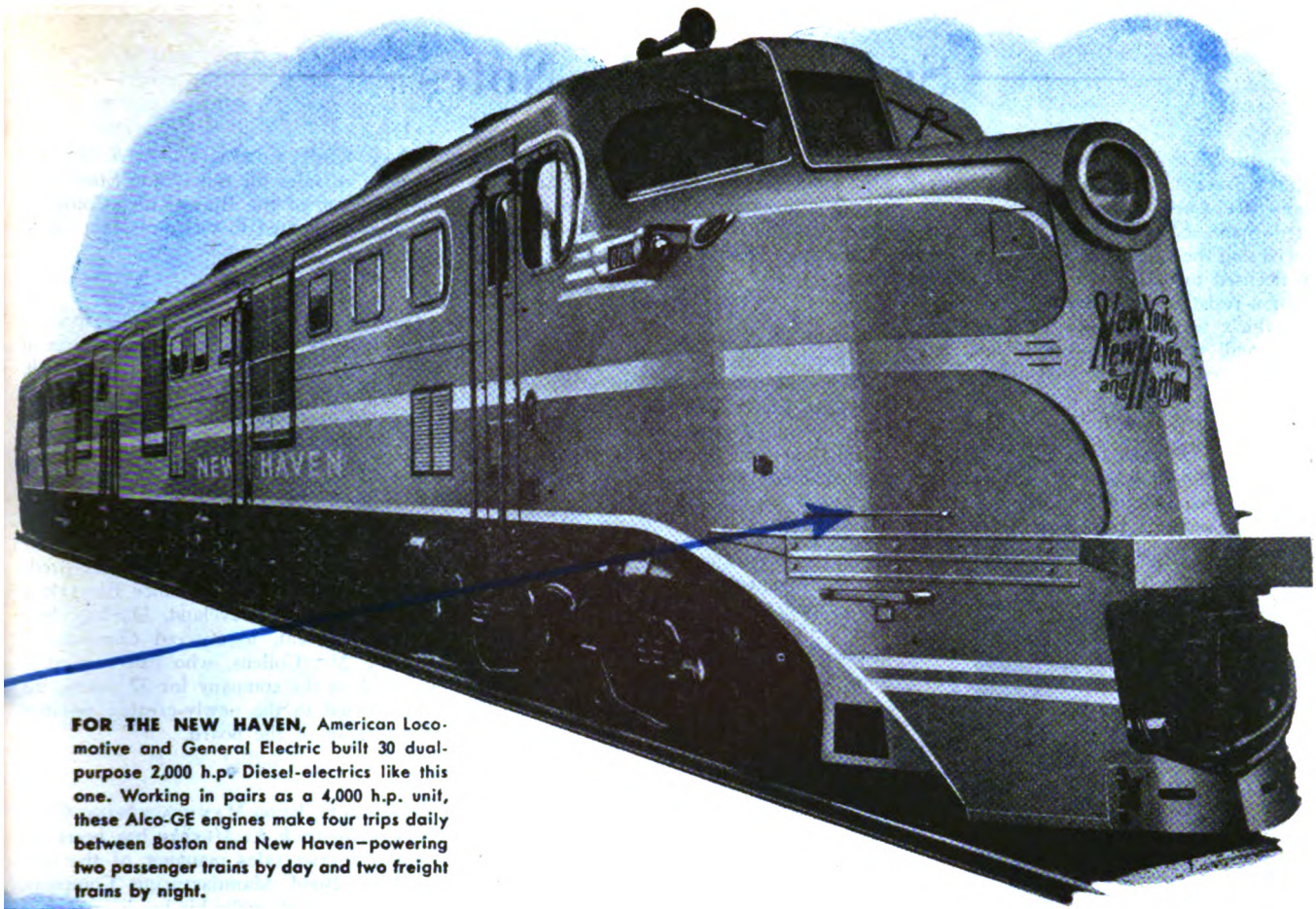
(Turn to second left-hand page)

FOR THE ROCK ISLAND, American Locomotive and General Electric built four 2,000 h.p. Diesel-electrics—locomotives now pulling such famous trains as the "Choctaw Rocket" from Memphis to Amarillo and the "Golden State Limited" from Chicago to Kansas City.



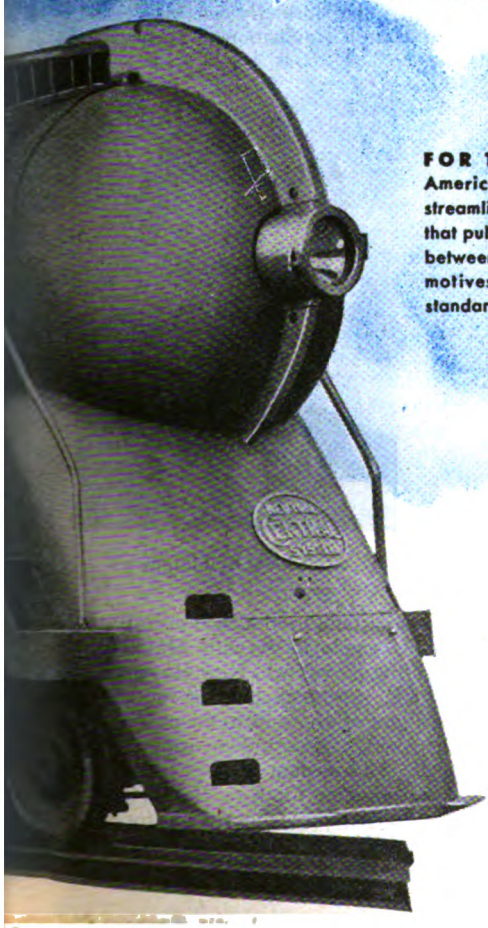
Each is unsurpassed for the job





FOR THE NEW HAVEN, American Locomotive and General Electric built 30 dual-purpose 2,000 h.p. Diesel-electrics like this one. Working in pairs as a 4,000 h.p. unit, these Alco-GE engines make four trips daily between Boston and New Haven—powering two passenger trains by day and two freight trains by night.

because each was built for the job!



FOR THE NEW YORK CENTRAL, American Locomotive built the powerful, streamlined Hudson-type steam locomotives that pull the famous 20th-Century. Operating between New York and Chicago, these locomotives have helped these trains set new standards in speed, comfort and convenience.

American Locomotive
NEW YORK

Supply Trade Notes

CARNEGIE-ILLINOIS STEEL CORPORATION; LUKENS STEEL COMPANY.—The Carnegie-Illinois Steel Corporation (subsidiary of the United States Steel Corporation) has announced that the Lukens Steel Company has been licensed to manufacture "Cor-Ten", a corrosion-resistant high strength, low alloy steel which was developed by Carnegie-Illinois and, up to the present time, has been produced solely by subsidiary companies of U. S. Steel.

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*Lloyd E. Huber,* for the past twenty-one months senior purchasing officer, car section, transportation corps, War Department, has been appointed sales

Lloyd E. Huber

agent of the Pullman-Standard Car Manufacturing Company and the Pullman-Standard Car Export Corporation, with headquarters in Washington. Prior to his appointment with the transportation corps, Mr. Huber was supervisor of priorities in the purchasing department of the Baltimore & Ohio, with which railroad he had been associated in various capacities in the stores and purchasing department since 1913.

◆

SUN OIL COMPANY.—*Dr. Edgar S. Ross* has returned to the Sun Oil Company at Philadelphia, Pa., where he will devote his full time to the development of technical sales with the industrial products department. For fifteen months, Dr. Ross had been chief of the lubricants section, aviation division, Petroleum Administration for War, Washington, D. C. Prior to serving with the P. A. W., he was assistant manager in charge of specialties, development division, for the Sun Oil Company at Marcus Hook, Pa.

◆

AMERICAN CAR AND FOUNDRY COMPANY.—*William L. Stancliffe,* vice-president of American Car and Foundry Company, at his own request, has retired from active service as head of its sales department. Mr. Stancliffe will remain with the company in a consultative capacity and will continue as a member of its board of directors. —*Justus W. Lehr* has been appointed district manager in charge of the American Car and Foundry Company plant at Chicago. *Preston J. Gearhart* has been appointed assistant district manager at Berwick, Pa.

◆

AMERICAN WELDING & MANUFACTURING COMPANY.—*Edward C. Fales,* assistant to the general manager of operations of the Sylvania Electric Products Company, has been appointed assistant to the president of the American Welding & Manufacturing Co., Warren, Ohio.

◆

CARBOLOY COMPANY, INC.—*A. F. Dobbrodt* has been appointed district manager of the Pittsburgh district office of the Carboloy Company at 704 Second avenue, Pittsburgh, Pa. Mr. Dobbrodt was previously district manager of the Southern district office at Birmingham, Ala. The Southern territory will now be handled from the Pittsburgh office.

◆

AMERICAN STEEL & WIRE COMPANY.—*C. E. Plass,* chief research engineer of the electrical cable works at the American Steel & Wire Company's South Works in Worcester, Mass., has been appointed district engineer in the electrical sales division of the company's Chicago office. *Victor Siegfried,* an instructor in electrical engineering at Worcester Polytechnic Institute since 1933, has been appointed to succeed Mr. Plass as chief research engineer of the electrical cable works.

◆

H. K. PORTER COMPANY.—The H. K. Porter Company, of Pittsburgh, Pa., has filmed a 16 mm. sound Kodachrome motion picture titled "Custom Built Power," which depicts the building of a 100-ton Diesel-electric switching locomotive. Presenting a comparison of locomotive and fashion changes from 1866 to the present, the film is a panorama of locomotive progress in the past 80 years together with major details of interest in the construction of the 100-ton Diesel. "Custom Built Power" has a showing time of 20 min., to which Porter will add from its film library, additional special films of interest to any particular group, providing a 40-min. show in all. George L. Phillips, public relations manager, is in charge of showings which are available on request.

Army-Navy "E" Awards

Babcock & Wilcox Company, Bayonne, N. J.

Buffalo Forge Company, Buffalo, N. Y Third renewal.

Carboloy Company, Inc., Detroit, Mich.

Fansteel Metallurgical Corporation, Tantalum Defense Corporation, North Chicago, Ill. Second star.

Westinghouse Electric & Manufacturing Company, Sharon, Pa. Fourth star.

BLAW-KNOX COMPANY.—*J. B. Kintner,* manager of sales for the Union Steel Castings division of the Blaw-Knox Company, has been promoted to vice-president of the division.

◆

GREAT LAKES STEEL CORPORATION.—*J. Emmett Fink,* general works manager of the Great Lakes Steel Corporation, Detroit, Mich., has been elected vice-president in charge of operations and *Julius A. Clauss,* chief engineer, has been elected vice-president in charge of engineering.

◆

RELIANCE ELECTRIC & ENGINEERING COMPANY.—*James W. Corey,* sales vice-president since 1940 of the Reliance Electric & Engineering Co., Cleveland, O., has been elected president, to succeed *Clarence L. Collens.* Mr. Collens, who had served as president of the company for 37 years, has been elected to the newly-created position of chairman of the board.

◆

EDWARD G. BUDD MANUFACTURING COMPANY.—*Goodrich K. Murphy* has been appointed district sales manager of the Edward G. Budd Manufacturing Company. Mr. Murphy will make his headquarters in the company's New York offices, working with Fitzwilliam Sargent, regional sales manager in New York, and Samuel M. Felton, general sales manager of the railway sales department at Philadelphia, Pa. Mr. Murphy was graduated from Yale University. He formerly was associated with the Matson Navigation Company, where he

Goodrich K. Murphy

was assistant to the vice-president. Prior to his employment with Matson, he was with the New York, New Haven and Hartford for ten years holding successively the positions of assistant to the passenger traffic manager, assistant passenger traffic manager, and assistant to the general manager. Before joining the New Haven, he was with the American Airlines, Inc., for six years until 1934, at which time he was eastern division traffic manager.

NATIONAL MALLEABLE & STEEL CASTINGS COMPANY.—*Howard W. Gilbert,* manager of the inspection and test department of the National Malleable & Steel Castings Company since 1918, has been promoted to engineering assistant to the president. Mr. Gilbert joined National Malleable in 1908. He was chairman of the mechanical committee of coupler manufacturers for a number of years. In his new position he will

H. W. Gilbert

supervise the specialty engineering, specialty development, product testing, road service, and coupler pattern departments. When war restrictions permit, the company plans to expand its product engineering and road service activities. *Harold N. Whitmore,* chief inspector at the company's general office, has been appointed manager of the inspection and test department to succeed Mr. Gilbert. After serving in the Army Air Corps in the last war, Mr. Whitmore joined National Malleable in 1923. He was employed at the company's Cicero, Ill., works from 1928 to 1931. *Archie J. Kashubeck,* of the department of specialty development at Cleveland Ohio, has been appointed sales agent at the San Francisco, Calif., office.

◆

ELECTRONIC LABORATORIES.—*Walter E. Peek,* for the past four years a member of the electric engineering staff of the Electronic Laboratories, Inc., Indianapolis, Ind., has been appointed sales manager.

◆

AIR REDUCTION SALES COMPANY.—*J. M. Driscoll,* manager of the Cleveland, O., industrial sales office of the Air Reduction Sales Company, has been appointed manager of railroad sales, northern division, for the company with offices in Cleveland.

◆

COOPER-BESSEMER CORPORATION.—*A. M. Burton* has been appointed assistant sales manager of the Cooper-Bessemer Corporation with headquarters at Mt. Vernon, Ohio.

◆

RALPH W. PAYNE.—*W. Conroy Wilson* has been appointed sales and service engineer for Ralph W. Payne, railway appliances and equipment, Washington, D. C.

◆

WHITING CORPORATION.—*Mullaney & Campbell,* Seattle, Wash., has been appointed exclusive sales representative in the Seattle territory for the Whiting Corporation, Harvey, Ill.

J. G. BRILL COMPANY.—*Charles O. Guernsey* has resigned as vice-president of the J. G. Brill Company, Philadelphia, Pa.

◆

PITTSBURGH SCREW & BOLT CORPORATION.—*George E. Horney* has been appointed assistant to the president and elected a director of the Pittsburgh Screw & Bolt Corporation, with headquarters at Pittsburgh, Pa. Mr. Horney formerly was resident vice-president of the company's Gary screw and bolt division. *Gerald J. Garvey,* a member of the sales department of the Gary screw and bolt division, has been appointed general manager of that division, with headquarters in Chicago.

◆

SAMUEL GREENFIELD COMPANY.—*David B. Joseph* has been appointed representative in the southern Ohio district, with headquarters in the Hotel Alms, Cincinnati, O., for the Samuel Greenfield Company of Buffalo, N. Y. Mr. Joseph formerly was vice-president and treasurer of the Edna Brass Manufacturing Company of Cincinnati.

◆

ALLOYS DEVELOPMENT COMPANY.—The Alloys Development Company has announced the licensing of the Carnegie-Illinois Steel Corporation and other subsidiaries of the United States Steel Corporation, the Republic Steel Corporation, and the Lukens Steel Company for the manufacture of "Aldecor," a steel of the "Cor-Ten" type, which resulted from the research of the Alloys Company and was developed by Republic during the past three years. With the recent announcement by Carnegie-Illinois that both Republic and Lukens have taken licenses for the manufacture of "Cor-Ten," the acceptance of licenses for the production of "Aldecor" makes both compositions available from several large producers.

◆

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—*P. C. Smith* has been appointed assistant to the manager of the transportation and generator division of the Westinghouse Electric & Manufacturing Company, and *J. S. Askey, G. L. Moses* and *P. G. Lessman* have been appointed section engineers in the department. Since January of last year, Mr. Smith has been assigned to special work in connection with power trains being built by Westinghouse at its New Philadelphia, Ohio, works. *David M. Salsbury,* general manager of the Westinghouse Electric Supply Company, wholesale marketing outlet of the Westinghouse Electric & Manufacturing Co., has been elected vice-president and general manager to head the supply company's operations.

◆

SHELDON MACHINE COMPANY, INC.—The Sheldon Machine Company, Inc., Chicago, builders of Precision Lathes and Arbor Presses, has acquired the Vernon line of machine tools. This line includes the horizontal milling machines, vertical milling machines and jig borers, 12-in. back-geared shapers and universal tool and cutter grinders heretofore built and sold by the Machinery Manufacturing Company of Los Angeles, Calif. All manufacturing of these machine tools has been transferred to the Sheldon plant in Chicago.

CHICAGO RAILWAY EQUIPMENT COMPANY.—*Rowland S. Folk* has been appointed eastern sales manager of the Chicago Railway Equipment Company, with headquarters at New York. Mr. Folk was previously connected with the Valve Pilot Company.

◆

TIMKEN ROLLER BEARING COMPANY, LTD.—This Canadian subsidiary of the Timken Roller Bearing Company of Canton, Ohio, has purchased from the city of St. Thomas, Ontario, approximately seventy-five acres of ground on the east side in Talbot street, as the site of a new bearing and rock bit plant. Design of the plant buildings will be started immediately and operations, requiring an estimated three hundred employees, will begin as soon as possible.

◆

WATERHOUSE & COMPANY.—*David M. Waterhouse,* formerly eastern representative in the railroad field for the Pantasote Company, has organized his own company under the name of Waterhouse & Co., with general offices in Plainfield, N. J., and a sales office at 30 Church street, New York. Mr. Waterhouse plans to open other sales offices when the war ends in Boston, Mass.; Pittsburgh, Pa., and Atlanta, Ga., and to supply the territory extending from Boston to Pittsburgh, and from Buffalo, N. Y., to Florida, with material suitable for the construction and maintenance of passenger-

David M. Waterhouse

train car equipment. The company plans to contact also the transit, bus, marine and airway fields in the same territory. Waterhouse & Co. will represent the following companies in these fields: A. Theo. Abbot & Co., Philadelphia, Pa., "Kapock" Aquapruf-Sunfast fabrics; Blanchard Bro. & Lane, Newark, N. J., leather coverings; Collins & Aikman Corp., New York, pile fabrics for seat coverings; R. L. Hanson, Inc., New York, equipment in steel, aluminum and stainless steel with fabrications by the Watson Manufacturing Company of Jamestown, N. Y.; Micro Molding Corporation, Plainfield, N. J., molded plastic materials for miscellaneous products of special design; Technical Ply-Woods, Chicago, resin bonded plywoods; Union Instrument Corporation, Plainfield, N. J., machine work in steel and brass for miscellaneous products of special design; and the Western Shade Cloth Company, Chicago, vinyl coated and pyroxylin coated artificial leathers.

(Turn to second left-hand page)

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on train communication

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INDUCTIVE TRAIN COMMUNICATION

I.T.C.

Dependable voice communication

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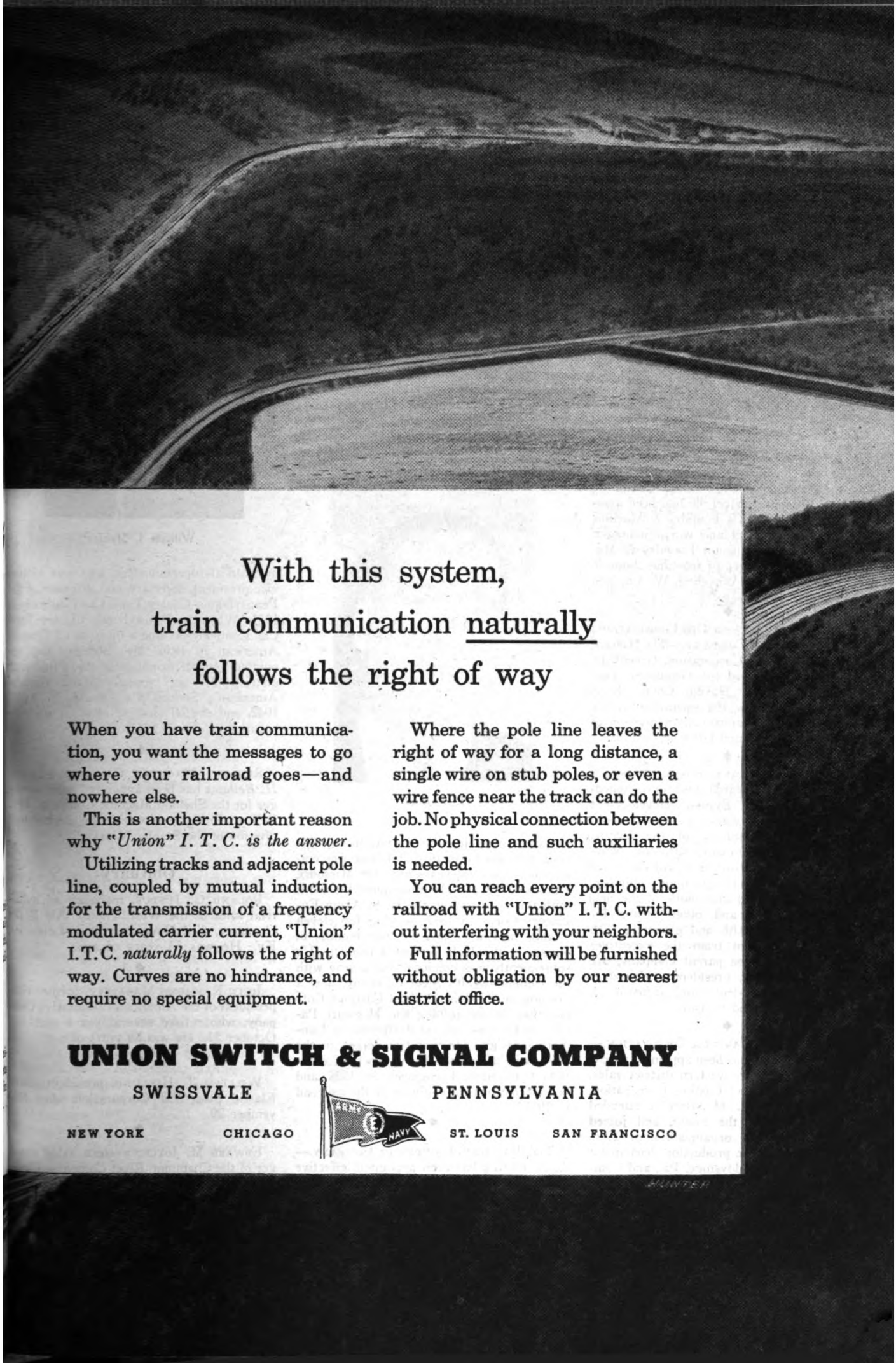
New bulletin tells the story

Requisites of a practicable train communication system . . . how "Union" I.T.C. meets all of these requisites . . . what it means in railroad operations . . . how it works . . . installations now in service.

Ask for a copy of Bulletin No. 160.



With this system, train communication naturally follows the right of way

When you have train communication, you want the messages to go where your railroad goes—and nowhere else.

This is another important reason why "*Union*" *I. T. C. is the answer.*

Utilizing tracks and adjacent pole line, coupled by mutual induction, for the transmission of a frequency modulated carrier current, "Union" I.T.C. *naturally* follows the right of way. Curves are no hindrance, and require no special equipment.

Where the pole line leaves the right of way for a long distance, a single wire on stub poles, or even a wire fence near the track can do the job. No physical connection between the pole line and such auxiliaries is needed.

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UNION SWITCH & SIGNAL COMPANY

SWISSVALE PENNSYLVANIA

NEW YORK CHICAGO ARMY NAVY ST. LOUIS SAN FRANCISCO

PITTSBURGH STEEL FOUNDRY COMPANY.—*John M. Mille* has been appointed assistant to the president of the Pittsburgh Steel Foundry Corporation, Glassport, Pa. Mr.

John M. Mille

Mille was formerly manager of the company's Arsenal Machine Shop. Prior to joining Pittsburgh Steel, he had been associated with the Lewis Foundry & Machine Co. as vice-president and works manager, and with the Continental Foundry & Machine Co. as manager of machine shops in East Chicago, Ind., Wheeling, W. Va., and Coraopolis, Pa.

◆

GREENFIELD TAP AND DIE CORPORATION; GEOMETRIC TOOL COMPANY.—The Greenfield Tap and Die Corporation, Greenfield, Mass., has purchased the Geometric Tool Company of New Haven, Conn. It is planned to continue the operation of the Geometric Tool Company as a division of the Greenfield Tap and Die Corporation.

◆

PYRENE DEVELOPMENT CORPORATION.—A new industrial research and development organization, the Pyrene Development Corporation of Newark, N. J., has been formed as a subsidiary of the Pyrene Manufacturing Company, also of Newark. The new organization will carry out research on fire extinguishing equipment and compounds and also work in the field of safety devices and other means for conserving life, health and property. The new officers, drawn from the executives and directors of the parent company, are *Charles G. Durfee,* president; *Edawrd J. Waring,* vice-president; and *Edward A. Clapp,* secretary and treasurer.

◆

GENERAL STEEL CASTINGS CORPORATION.—*F. B. Barclay, Jr.,* has been appointed assistant to the manager, western district sales, of the General Steel Casting Corporation, at Granite City, Ill. Mr. Barclay attended the University of the South, and joined the General Steel organization in 1930. After serving in the production department of the company's Eddystone, Pa., and Commonwealth plants, he was transferred to the sales department at Granite City in 1935. He was sent to the Chicago district sales office in 1939 and returned to the production department as assistant to the works manager, Commonwealth plant, in 1941.

PHILCO CORPORATION.—*William S. Hogg* has been appointed to the mid-western sales staff of the storage battery division of the Philco Corporation, with headquarters in Cincinnati, Ohio. Mr. Hogg will represent the Philco storage battery division in the Indianapolis, Ind., Louisville, Ky., and Cincinnati, Ohio, area. *R. P. M. Carmody* has been appointed sales representative in the Buffalo, N. Y., area for the storage battery division, with headquarters in the Ellicott Square Building, Buffalo. Mr. Carmody began his career with the Westinghouse Electric & Manufacturing Company, and subsequently was in charge of electrical and mechanical work for the Buffalo Steel Car Company. He formed his own agency to handle electrical and associated equipment in 1936.

◆

AMERICAN LOCOMOTIVE COMPANY.—*R. F. Abell,* mechanical engineer of the Missouri Pacific, has been appointed assistant to the chief mechanical engineer of the American Locomotive Company with headquarters at Schenectady, N. Y. Mr. Abell completed

R. F. Abell

his apprenticeship with the Atchison, Topeka & Santa Fe in 1916 and later was employed for several years with the Missouri, Kansas & Texas. He interrupted his work with this road to join the U. S. Army Engineers Corps in 1917, serving for eleven months in France and for five months in Russia in the Kola peninsula district. He subsequently was employed for a year with the Commonwealth Steel Company, now a division of the General Steel Castings Corporation, before joining the Missouri Pacific in 1925 as general draftsman in locomotive design. He was transferred to the Missouri Pacific's southern properties as assistant mechanical engineer in 1928 and became mechanical engineer of the railroad in 1935.

◆

T-Z RAILWAY EQUIPMENT COMPANY.—*L. R. Gurley* has been appointed, effective January 1, vice-president of the T-Z Railway Equipment Company, with headquarters at 8 South Michigan avenue, Chicago. Mr. Gurley, in addition to engineering and production responsibilities, will be in charge of railway sales in eastern and northeastern United States.

GENERAL AMERICAN TRANSPORTATION CORPORATION.—*William J. Stebler,* vice-president of the General American Transportation Corporation, has been transferred to Chicago as general supervisor of manufacturing for the entire corporation. Mr. Stebler is an alumnus of Duquesne University. He began his business career with the Conley Tank Car Company in Pittsburgh, Pa., in 1924, serving as traffic manager and

William J. Stebler

mechanical superintendent, and was elected vice-president, secretary and director of the Pennsylvania-Conley Tank Car Company in 1931. When the Pennsylvania-Conley Tank Car Company became a division of General American in 1936, Mr. Stebler was appointed general manager of the Pittsburgh district. He was transferred to General American's Sharon, Pa., works in April, 1942, and elected vice-president of the corporation in April, 1943.

◆

SHELDON MACHINE COMPANY.—*Lyman H. Bellows* has been appointed sales manager for the Sheldon Machine Company. Mr. Bellows formerly was with the electric tool division of the Stanley Works.

Obituary

ROLAND G. JUSTUS, manager of industrial sales of the Westinghouse Air Brake Company, died November 30 in Louisville, Ky. He was 53 years of age.

◆

JOHN RAYMOND MAGARVEY, former vice president of the American Locomotive Company, who retired several years ago, died October 31. He was 88 years of age.

◆

WILLIAM T. HEDLUND, president of the Elastic Stop Nut Corporation, died November 29.

◆

EDWARD M. JOYCE, western sales manager of the Champion Rivet Company, Cleveland, Ohio, died in St. Paul, Minn., on November 14 of a heart ailment while on a business trip. At one time Mr. Joyce was manager of the Cleveland Steel Car Company, and formerly was vice-president of the Illinois Car Manufacturing Company, Hammond, Ind.

Personal Mention

C. L. DICKERT, superintendent of motive power of the Central of Georgia at Savannah, Ga., has retired

J. W. HAWTHORNE, assistant to superintendent of motive power of the Central of Georgia at Savannah, Ga., has been appointed superintendent of motive power, with headquarters at Savannah.

RALPH L. SIMPSON, assistant to the former receiver of the Wisconsin Central (part of the Minneapolis, St. Paul & Sault Ste. Marie) at Minneapolis, Minn., has been appointed general manager of the Soo Line, with headquarters at Minneapolis. Mr. Simpson was born at Stratford, Ont., on Dec. 26, 1892, and entered railway service in March, 1913, as a draftsman in the employ of the Grand Trunk Pacific (now part of the Canadian National) at Transcona, Man. In July, 1917, he went with the Soo

Ralph L. Simpson

Line as chief draftsman at Minneapolis, and in April, 1923, was appointed mechanical engineer. In March, 1937, Mr. Simpson became assistant to the vice-president and general manager; one year later, assistant to the operating officer and in March, 1943, assistant to the receiver.

RUDOLPH L. KLEINE, assistant chief of motive power-car, of the Pennsylvania, who has retired, as announced in the November issue of the *Railway Mechanical Engineer*, was born at Philadelphia, Pa., on December 31, 1874. He attended Drexel Institute and began his railroad career on August 17, 1890, with the Philadelphia, Baltimore & Washington (part of the Pennsylvania). He became foreman on the Central division in December, 1900; general foreman at Washington, D. C., in May, 1901; general car inspector in July, 1902; assistant chief car inspector, lines east, in May, 1906; chief car inspector, lines east, in October, 1906, and assistant chief of motive power-car in 1920. For the past 32 years Mr. Kleine has been directly associated, first, with the development of a standard coupler and, then, with the constant study which has since been devoted to its revision and improvement. He became chairman of the Committee on Couplers and Draft Gear Equipment of the Master Car Builders' Association following the adoption by the association of the coupler standardization project in 1911, and directed it from the outset. Under his direction the committee developed the Type D coupler which was

R. L. Kleine

adopted as standard by letter ballot of the members of the Master Car Builders' Association in 1916 and proposed the Type E coupler, the contours of which were adopted as standard in 1933. He served continuously as chairman of the Coupler and Draft Gear Committee of the Master Car Builders' Association and, after 1919, of the Mechanical Division, until his resignation effective for the present association year. During this extended period of service Mr. Kleine won the respect both of railway men and manufacturers for the fairness with which he handled the relations of the two groups.

DEAN F. WILLEY, general mechanical superintendent of the New York, New Haven & Hartford at New Haven, Conn., has been appointed assistant general manager in charge of engineering, maintenance and mechanical departments, headquarters at New Haven, as announced in the December issue. Mr. Willey was born at Manchester, N. H., on August 5, 1896, and is a graduate of the Massachusetts Institute

Dean F. Willey

of Technology (1920). He entered railroad service with the New York, New Haven & Hartford in June, 1920, as assistant engineer, department of tests. On April 1, 1923, was appointed general material supervisor, October, 1923, mechanical inspector, and in November, 1923, foreman mechanical inspector at Boston, Mass., and in July, 1924, acting general foreman. Mr. Willey became general foreman on November 1, 1924, assistant to superintendent of shops at Readville, Mass., on September 16, 1925, and special mechanical assistant at New Haven on May 16, 1930. He served as mechanical superintendent from January, 1937, to May, 1941, when he was appointed general mechanical superintendent.

H. J. LAVINE has been appointed assistant fuel supervisor of the Minneapolis, St. Paul & Sault Ste Marie, with headquarters at Superior, Wis.

M. W. MCMAHON has been appointed locomotive appliances inspector of the New York Central System with headquarters at New York.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

KRANE KAR.—Silent Hoist Winch & Crane Co., 841-877 Sixty-Third Street, Brooklyn 20, N. Y. Catalog No. 58 descriptive of the Krane Kar mobile swing boom crane for use inside plants and shops, as well as outside in yards and for transferring loads between shops.

◆

BURSTING PRESSURES OF SEAMLESS TUBING.—Globe Steel Tubes Company, Milwaukee 4, Wis. Bulletin 112—a reference chart for engineers with tables of bursting pressures of seamless steel tubing from ⅛ in. to 9⅜ in. outside diameter.

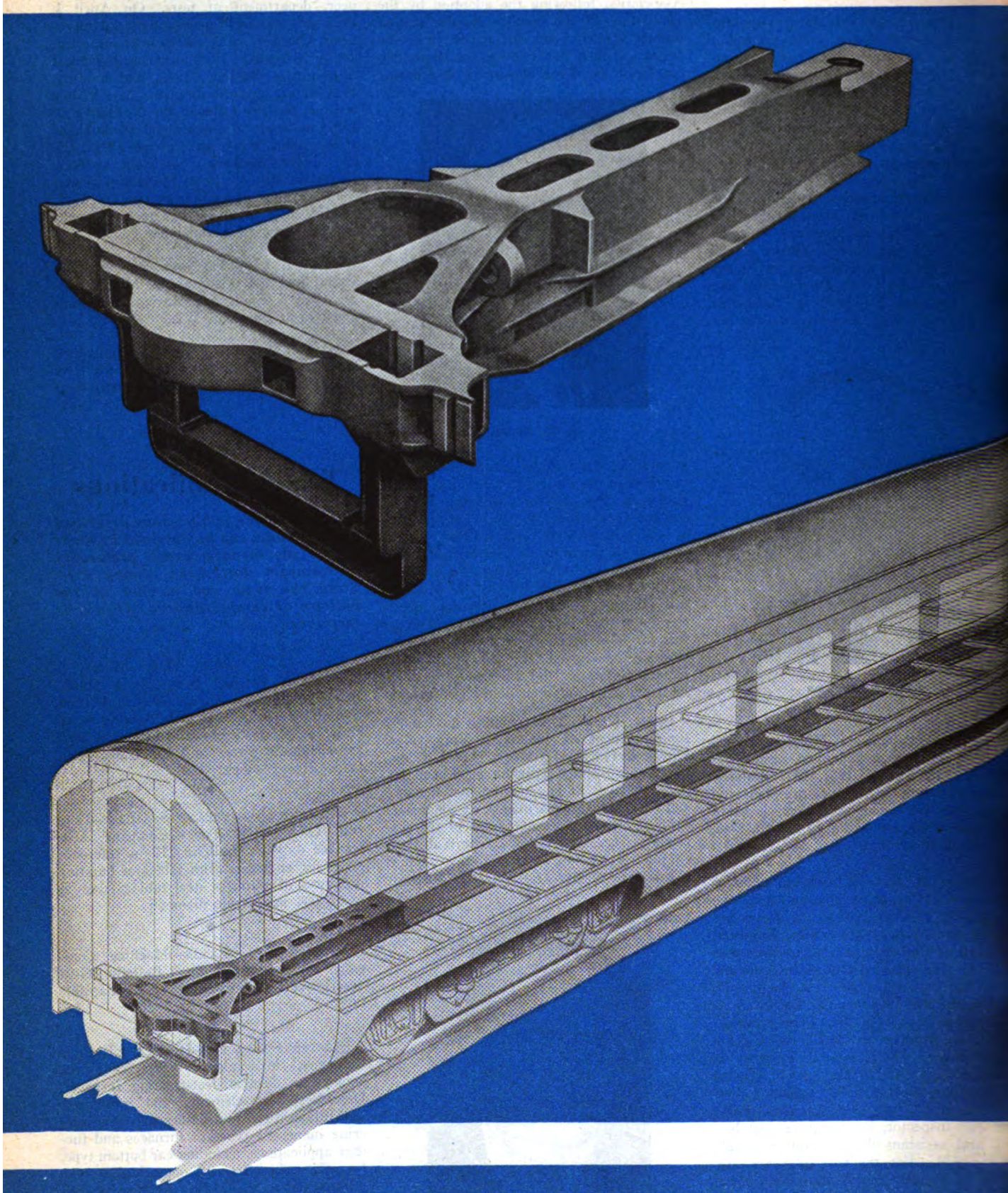
◆

LANDIS TAPS.—Landis Machine Company, Waynesboro, Pa. Bulletin G-94 descriptive of Landis Style ALT collapsible taps.

◆

ELECTRIC FURNACES.—Hevi Duty Electric Company, Milwaukee, Wis., forty-page booklet on electric heat-treating furnaces. Describes heat elements and mountings with illustrations and descriptive data covering numerous types of furnaces and furnace applications, including car bottom type, for various heat-treating operations in railroad maintenance work. References also given to additional bulletins for detail information regarding size, installation and use of particular types.

Your New Passenger



GENERAL STEEL

Transportation Library

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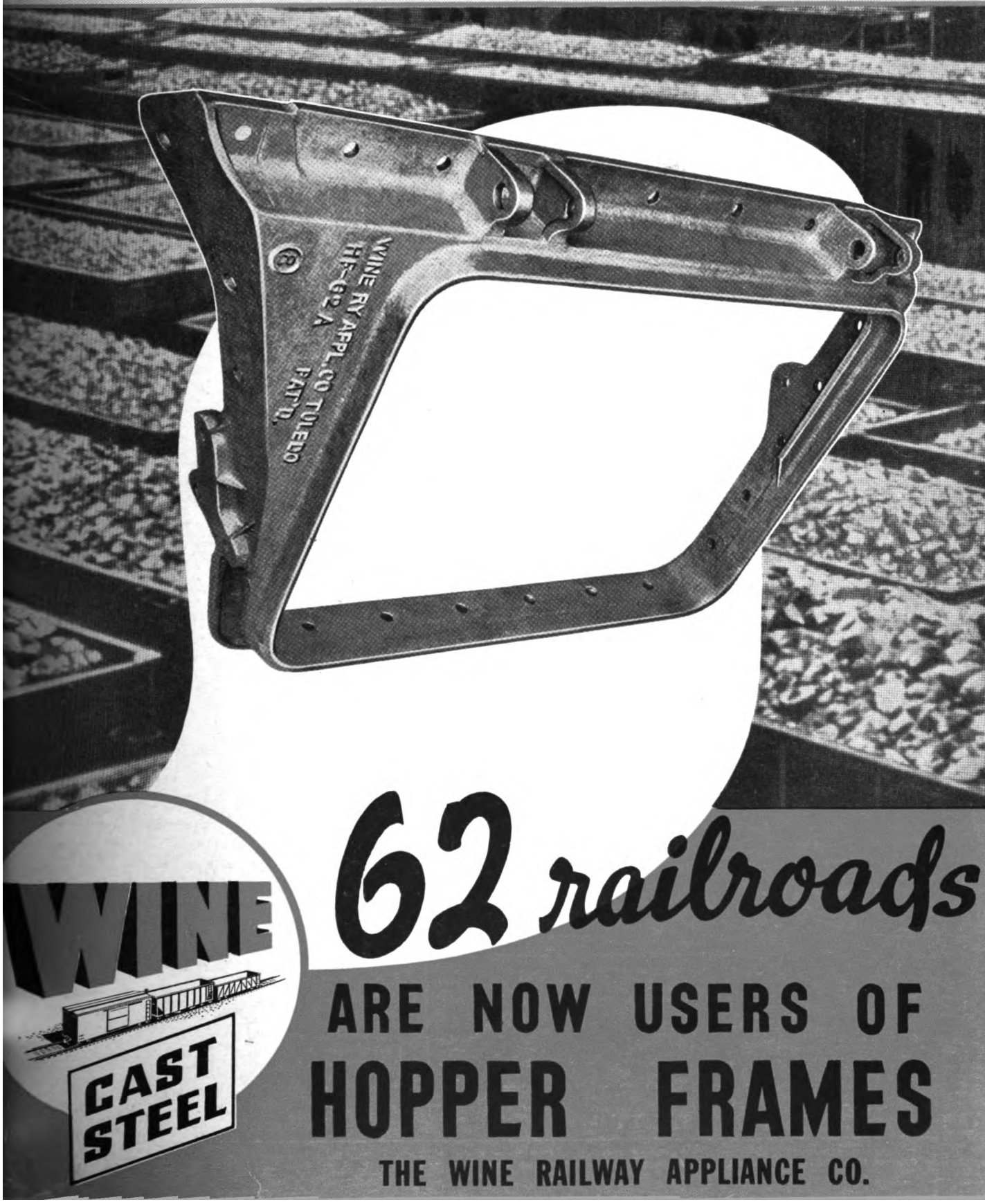
February
1945

TRANSPORTATION LIBRARY

Railway Mechanical Engineer



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62 railroads

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UNIT TRUCK

Has Established its Economy In all Types of Freight Equipment

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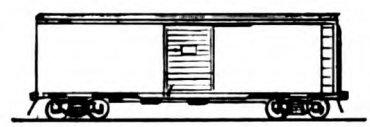
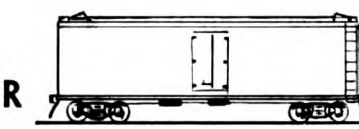
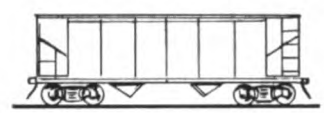
13783 BOX CARS



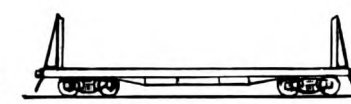
507 REFRIGERATOR



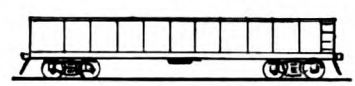
7761 HOPPERS



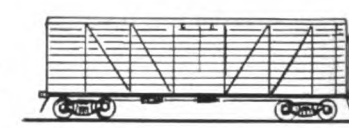
265 PULP WOOD



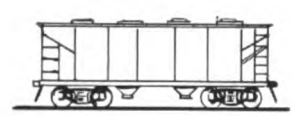
2450 GONDOLAS



200 STOCK CARS



1115 COVERED HOPPERS



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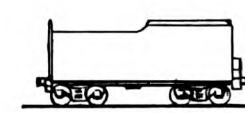

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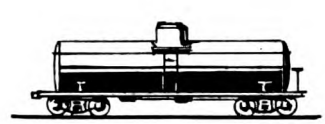

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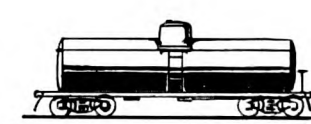

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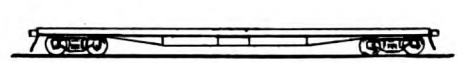

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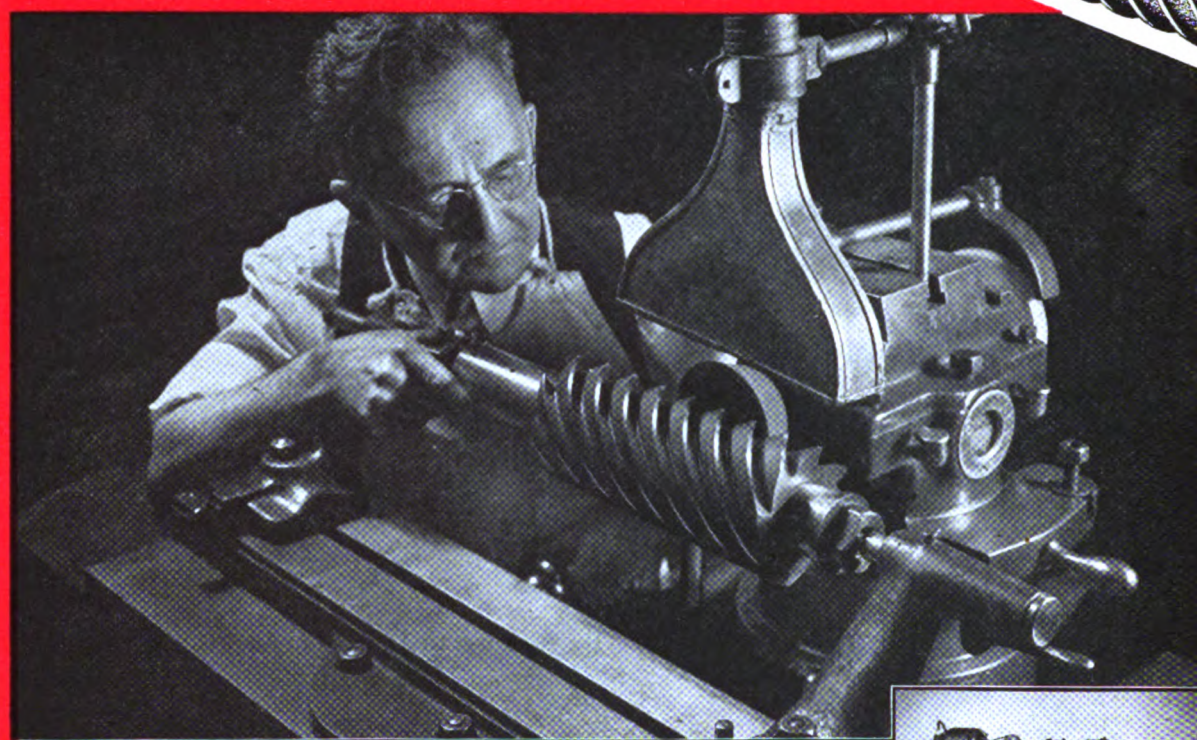

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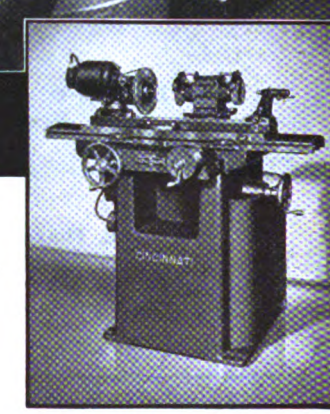

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Carry-Over from Boilers*

By Arthur Williams†

A discussion of the nature of carry-over – Its effect on the locomotive and on the superheater – A steam separator system for eliminating carry-over described and the results of tests recorded

In this paper, carry-over is defined as any substance leaving the boiler other than dry steam. This includes moisture in any form, regardless of the mechanism which caused it to enter the steam path, as well as suspended solids.

In approaching the problem of carry-over in locomotive boilers some tests were made in the laboratory of the Superheater Company at East Chicago, Ind., in 1939. The results are shown in Table I, each line being the average of several tests. These tests showed that under conditions approximating the worst that may be found in locomotive operation, it was possible for foam to carry a very high percentage of moisture, and that it should not be difficult to collapse this foam. This would indicate the desirability of an apparatus to collapse the foam and to be capable of discharging large amounts of moisture.

In 1938, a series of investigations was started by the Electro-Chemical Engineering Corporation and Dearborn Chemical Company to study visually the behavior of the water and steam in a locomotive boiler. Tests made on the St. Louis-San Francisco, Texas & Pacific, and Kansas City Southern led to an elaborate investigation on the Missouri Pacific. As a result of these tests the "Electromatic" foam-collapsing system was developed.

The effects of carry-over will, of course, depend upon the nature of the substances leaving the boiler. The greater part of carry-over is usually moisture but it is possible to have an appreciable amount of solid matter. Table II gives the analyses of scale found in superheater units from eleven different railroads in all parts of the country. It can be assumed that some of this matter would find its way into the multiple throttle, valve chests, and cylinders. In most cases, there is a high proportion of silica and alumina. With such substances being carried into the valve chests and cylinders, it can easily be understood why carry-over will cause rapid wear of bushings and packing. At the same time, lubrication will be adversely affected and wear of reciprocating parts accelerated. The analyses are arranged in descending order as to the percentage of silica and alumina taken together. As the percentage of these two substances decreases, the amount of oil and other organic matter increases.

Probably the worst effect of carry-over is in relation to the superheater. For a given operating condition the amount of heat taken up by the superheater units is fixed, and the moisture entering the superheater will reduce the final steam temperature, since some of the heat will be required to evaporate this moisture before superheating can begin. Steam tables show that for the same heat ab-

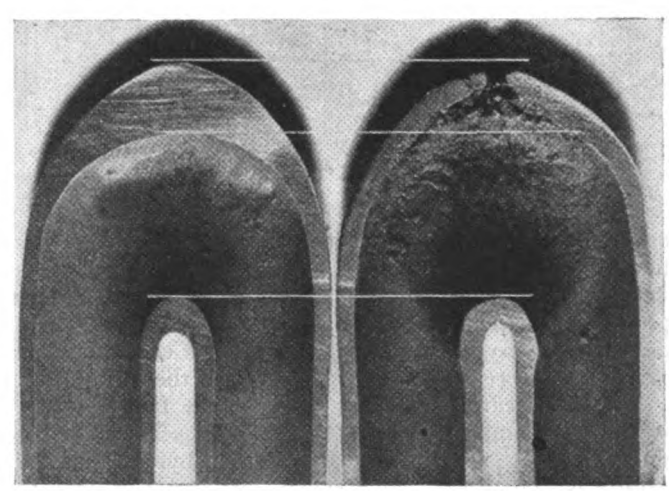


Fig. 1—New and failed superheater-unit return bends

* From a paper sponsored by the Railroad Division and presented at the annual meeting of the American Society of Mechanical Engineers at New York on November 30, 1944.

† Chief engineer, The Superheater Company, East Chicago, Ill.

Table I—Tests with Foaming Solutions

Test series No.	Boiler pressure, lb. per sq. in.	Water temp ent boiler, deg. F.	Quantities leaving boiler, lb. per hr. Total steam and moisture	Dry steam	Moisture	Liberation rate, lb. per hr. per sq. ft. water surface	Moisture from boiler, per cent	Remarks
1	194	368	518	216	302	998	58.3	5,000 p.p.m.* (292 grains per gal.) soap
2	192	348	1280	238	1042	2470	81.4	5,000 p.p.m. (292 grains per gal.) soap
3	182	363	422	223	199	814	47.2	1,400 p.p.m. (82 grains per gal.) sodium salts; 80 per cent sodium sulphate, 20 per cent sodium chloride
4	181	365	1797	159	1638	3460	91.2	2,800 p.p.m. (163 grains per gal.) sodium salts; 80 per cent sodium sulphate, 20 per cent sodium chloride

* Parts per million.

Table II—Analyses of Scale in Superheater Units

Sample	1	2	3	4	5	6	7	8	9	10	11
	Per cent										
Oil	0.05	0.05	0.08	0.33	0.06	0.08	2.25	1.40	1.01	23.90	Present
Other organic and volatile	1.67	...	1.30	6.04	5.20	...	4.12	0.40	11.26	13.05	32.80
Silica	16.23	39.35	51.05	37.07	31.36	37.62	33.80	9.70	7.36	12.10	6.85
Calcium carbonate	22.42	14.70	4.60	3.16	17.82	37.07	37.93	19.55	50.88	24.10	41.80
Lime*	...	3.27	...	17.11	...	...	...	...	...	...	...
Calcium sulphate	...	0.88	Trace	0.56	12.08	Trace	1.30	0.88	0.06	6.47	...
Magnesia	0.60	2.91	24.84	3.04	1.89	15.35	10.58	4.49	4.65	5.75	10.53
Iron oxide	5.02	17.6	10.82	3.62	10.00	4.00	5.62	40.00	4.50	9.20	2.49
Alumina	47.94	21.16	7.00	16.70	20.64	5.70	4.00	23.00	19.53	2.40	2.00
Sodium chloride	...	...	0.31	1.75	...	0.08	0.40	...	0.21	...	...
Sodium sulphate	3.43	...	...	...	...	...	...	...	...	...	...
Alkalies	2.64	...	...	10.00	...	...	...	0.58	...	3.03	3.55
Oil and other organic matter	1.7	0.05	1.4	6.4	5.3	0.8	6.4	1.8	12.4	37.0	32.8
Silica and alumina	64.2	60.5	58.1	53.8	52.0	43.3	37.8	32.7	26.9	14.5	8.9

* In combination with other oxides.

sorbed per pound of steam, there is a decrease in superheat of approximately 15 deg. for each one per cent moisture entering the superheater. A loss of 15 deg. steam temperature means a decrease of 1.5 to 2 per cent in cylinder efficiency with a corresponding increase in water and fuel consumption. A severe carry-over will result in the loss of all the superheat, so that saturated steam and water will enter the cylinders.

Tests made many years ago showed that the use of superheated instead of saturated steam resulted in an increase of 25 to 30 per cent in efficiency and power. These tests were made with relatively low superheat. With modern high steam temperatures, the loss of power due to loss of superheat can be even greater.

With large sums of money being spent for fuel it is readily seen that carry-over may cause an appreciable in-

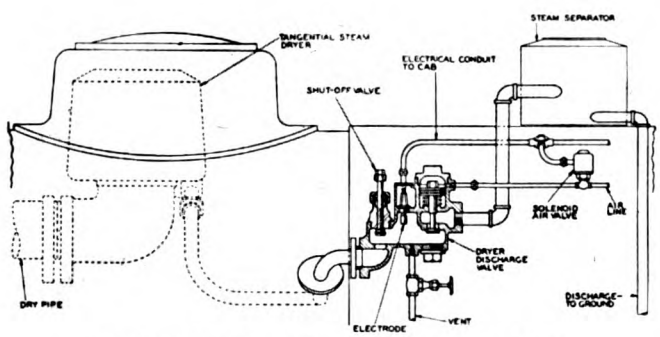


Fig. 2—Steam dryer with discharge to atmosphere

crease in the fuel bills. Furthermore, the carry-over is likely to occur when the locomotive is being worked at its hardest. This means that, at a time when the maximum power output of the locomotive is required so that train movements may be made with maximum efficiency, the carry-over decreases the power output of the locomotive.

Continued carry-over may result in the failure of the superheater units in service. When the back end of the unit is heavily coated with scale, it is obvious that the failure is due to the scale deposits. It is not so easy to understand those failures which occur in actual practice when the metal is practically free from scale.

Assume that a locomotive is being worked at high capacity, which means a high temperature of the gases at the back tube sheet and a high gas velocity in the superheater flues; under these conditions, there should be a correspondingly high steam velocity inside the superheater-unit tubing. Now assume that in one unit the steam flow is restricted, such as would occur if there were a scale deposit at any point in the tubing between the entrance and exit. One effect is that the steam temperature leaving this particular unit will increase because there is a reduction in the weight of steam and, therefore, an increase in the heat added per pound of steam. Furthermore, the decrease in the steam velocity will lower the heat-transfer coefficient at the inside surface of the tubing. Both these effects increase the metal temperature. A reduction in the proper steam velocity will give an appreciable increase in the metal temperature. With a steam flow approximately 50 per cent of normal, the metal temperature reaches 1,015 deg. F. and with 23 per cent of normal, the metal temperature is 1,200 deg. F. At such temperatures, there is a rapid attack on the steel by steam.

A number of investigations have been made at Purdue University to determine the corrosion rate of various steels in contact with steam at elevated temperatures. The results for mild steel show a slight amount of corrosion at 1,000 deg. F. At 1,050 deg. F., the corrosion rate starts to increase rapidly. At 1,200 deg. F. the corrosion rate is 15 times greater than that at 1,050 deg. F.

In comparing laboratory tests with the results obtained under service conditions, consideration must be given to the effect of alternating thermal and mechanical stresses in the metal which tend to cause fissures through which the steam can reach the metal. In this respect, the conditions in a locomotive superheater are perhaps the worst that can be imagined. Every change in the locomotive operating conditions results in a change in the temperatures and stresses in the superheater-unit metal. It is the combination of elevated metal temperatures and alternating stresses which results in the rapid deterioration of superheater units reported in a number of cases. The failure may occur in the superheater-unit return bend or in the tubing close to the return bend.

Fig. 1 shows a return bend that has failed in service. For comparison, a new return bend made by the same

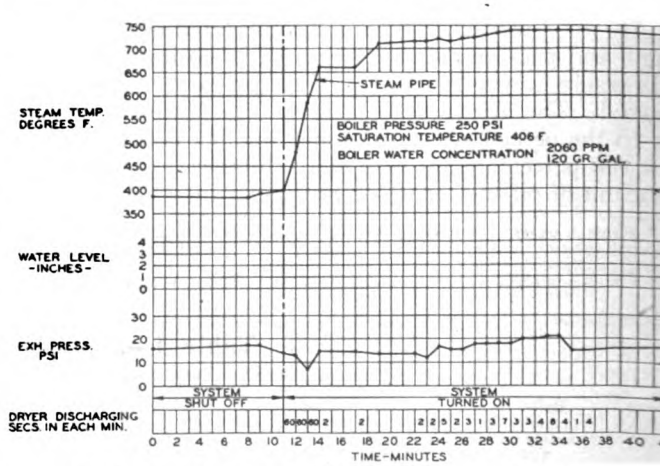


Fig. 3—Test of steam dryer with discharge to atmosphere

process and of identical material is also shown. The black material at the inside edge of the failed return bend is magnetic oxide. Comparison of the inside contour of the

two return bends indicates the continual process of formation of magnetic oxide and subsequent breaking away of part of the layer. The process continues until the metal becomes sufficiently thin for steam pressure to rupture it.

With the metal at elevated temperatures, there will also be corrosion of the steel by the oxygen in the flue gases in contact with the outside of the unit. The extent of this corrosion will depend upon the condition of the outside surface of the unit. It will usually be less when coal is used as a fuel than with oil. This is because there is usually some slag formation at the back end of the unit with coal. With an oil burner the sanding of the flues will keep the metal surface clean and allow increased contact between the steel and the oxygen.

The prevention of carry-over may be accomplished by control of the foaming, the removal of the foam after it is formed, or a combination of the two methods. In the first group are feedwater treatment, antifoam compounds, and control of concentration for the operating conditions.

For given operating and feedwater conditions, the most general method for controlling carry-over is by blowing down the boiler to reduce the concentration of solids. Since this reduces both the dissolved and suspended solids it does not make a great deal of difference which is the more important in the production of foam. The blowing down may be done in any of three ways:

1—With manual control by the engine crew. If the boiler water concentration is controlled by this method only, it is necessary for the supervisory forces to give proper instructions to the engine crews so that the blowing is in correct relation to the feedwater and operating conditions. The most common method of control is to take samples of the boiler water at the beginning and end of each run and to keep records of the concentrations.

2—By a continuous blow down. With this type of equipment, a predetermined quantity of water is continuously discharged to the atmosphere while the locomotive is working. The blow-down valve is automatically opened in response to steam-chest pressure.

3—Intermittent blow down, automatically operated by the conditions existing in the boiler at the time. This is accomplished by a device known as the "signal foammeter."

Another system consists of a steam separator in the boiler connected to a discharge valve on the outside of the boiler so that any carry-over is blown to the atmosphere. The arrangement of the apparatus is shown in Fig 2.

Previous investigations had shown the possibility of large quantities of moisture being carried over under foaming conditions. Considerable development resulted in a design of steam separator known as the "tangential dryer," which is extremely efficient at all steam velocities and is capable of handling high percentages of moisture.

Referring to Fig. 2, the tangential dryer is located at the dry-pipe entrance. The discharge from the dryer through which the separated moisture is delivered is connected to a discharge valve mounted on the outside of the boiler. When any moisture is carried into the discharge valve, an electrical circuit is completed through an electrode to operate a relay which opens a solenoid valve. This admits air to the piston which operates the discharge valve. The discharge from the valve is connected to a separator on top of the boiler so that the steam is discharged to the atmosphere and only hot water to the ground. A vent pipe with a small orifice leads from the discharge valve to a point of lower pressure, such as a superheated steam auxiliary pipe. The small quantity of steam which flows through the orifice keeps the discharge valve free of air and establishes a flow condition which insures the prompt action of the valve as soon as moisture enters the steam dryer.

To determine the performance of the dryer discharge valve, tests were run on a western railroad which was known to have very bad foaming conditions. During the tests the boiler evaporation was from 70,000 to 100,000 lb. of steam per hr. The tangential dryer was fitted to a 9½-in. dry pipe, and the 2-in. dryer discharge valve had a capacity of 40,000 lb. per hr. of saturated water at boiler pressure. The performance of the dryer discharge system was determined by comparative tests made with the system turned on and shut off. The test results are given in Figs. 3 to 5, inclusive. These tests were run over the same territory on three successive days, with the last two

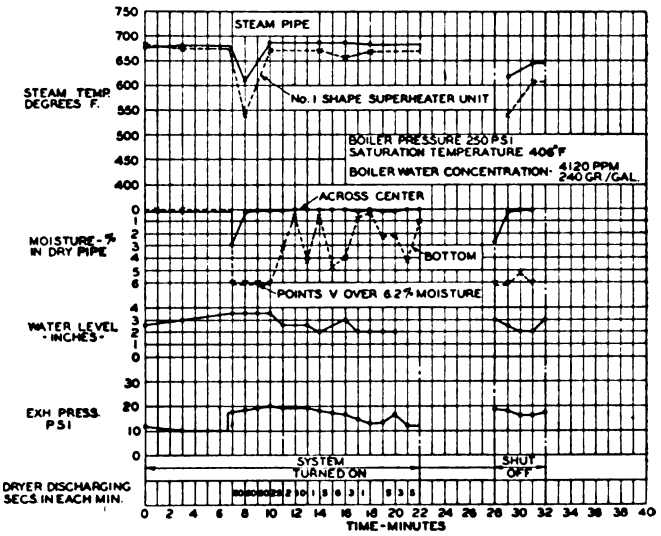


Fig. 4—Test of steam dryer with discharge to atmosphere

series being run on the same day, so that as far as possible the tests with the system turned on and shut off were made under the same conditions.

The steam temperature was taken in the steam pipe and also leaving a No. 1 shape superheater unit. This is in the top row of units and is connected into the header at a point nearest to the dry-pipe entrance. Moisture naturally flows first into this shape unit and its presence is indicated by the difference between the temperature of the steam leaving the unit and the steam-pipe temperature. The moisture in the dry pipe was measured by two throttling calorimeters. One was connected to a standard A. S. M. E. sampling tube across the center of the dry pipe. Since the tangential dryer imparts a whirling action to the steam, a second calorimeter was connected to a sampling tube, consisting of a piece of ½-in. pipe extending into the bottom of the dry pipe ¼ in., with the side toward the direction of flow cut away.

The four readings mentioned gave an indication as to the extent of carry-over into the superheater. Sight glasses were installed in the dome cover so that visual observation could be made of the conditions inside the boiler. Readings were taken of the water level and the exhaust pressure, the latter being a measure of the rate of working of the locomotive. A record was made of the number of seconds in each minute of testing that the dryer discharge valve was open. A short electrode mounted in the dome cover would operate a signal light in the cab when the water-and-steam density was sufficient to complete an electrical circuit.

The results are given in the form of curves showing the change in the various observations for each minute of testing. The first test, shown in Fig. 3, does not in-

clude all of the readings taken in subsequent tests, but is reported because it illustrates a very bad condition of carry-over. With the boiler under foaming conditions, readings were taken for the first 11 min., recorded in Fig. 3, with the dryer discharge system shut off. The steam temperature in the steam pipe was at boiler saturation temperature, and water was being thrown out of the stack and through the cylinder cocks, which were open. After 11 min., the dryer discharge system was turned on. The discharge valve opened and blew steadily for 3 min. and at short intervals thereafter. At the end of 3 min. the steam temperature had increased from 400 to 660 deg. F. and 19 min. after the dryer discharge valve had been opened the steam-pipe temperature had reached 740 deg. F. From the twenty-second min. to the thirty-seventh min. the dryer was discharging for intervals varying from 1 to 8 sec. per min., showing that carry-over into the dryer was still occurring, and that the moisture and solids were being separated and discharged to the atmosphere.

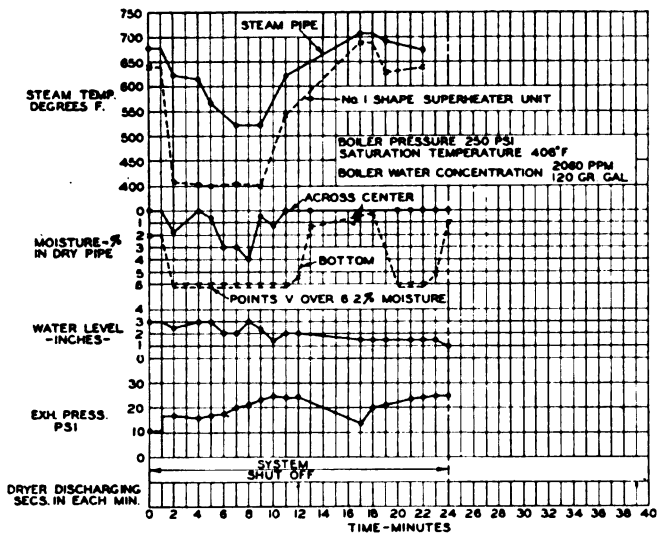


Fig. 5—Test of steam dryer with discharge to atmosphere

After this test, it was realized that it would be better to produce a standard test condition so that the locomotive operation with and without the dryer discharge valve in action could be determined. Fig. 4 shows how this was done. The locomotive was operated at approximately 10 lb. exhaust steam pressure and, when conditions were steady, several readings were recorded. The rate of evaporation from the boiler was then suddenly increased by increasing the cutoff, and observations were made of the results of the carry-over.

Referring to Fig. 4, the rate of evaporation was suddenly increased just before the seventh min. as indicated by a rise in the exhaust pressure from 10 to 18 lb. per sq. in. Immediately, carry-over started and the dryer discharge valve opened. For 3½ min. the dryer discharge valve was open continuously. There was a momentary drop in the steam temperatures and increase in the dry-pipe moisture, but after 3 min. the steam-pipe temperature was back to normal, and the steam temperature leaving the No. 1 shape unit showed only a slight amount of moisture. The calorimeter connected to the center sampling tube showed dry steam, and that connected to the bottom showed some moisture.

It should be pointed out that, while the moisture readings are represented as actual quantities, they should not be interpreted too literally. It is only possible to obtain a true sample when the steam-and-water mixture is homogenous, and this is not possible in a dry pipe after the steam has left a dryer which has subjected the steam and water to a centrifugal action. At the end of the test shown in Fig. 4, a few more readings were taken with the dryer discharge system shut off. These readings show moisture entering the superheater as indicated by the steam-temperature and calorimeter readings.

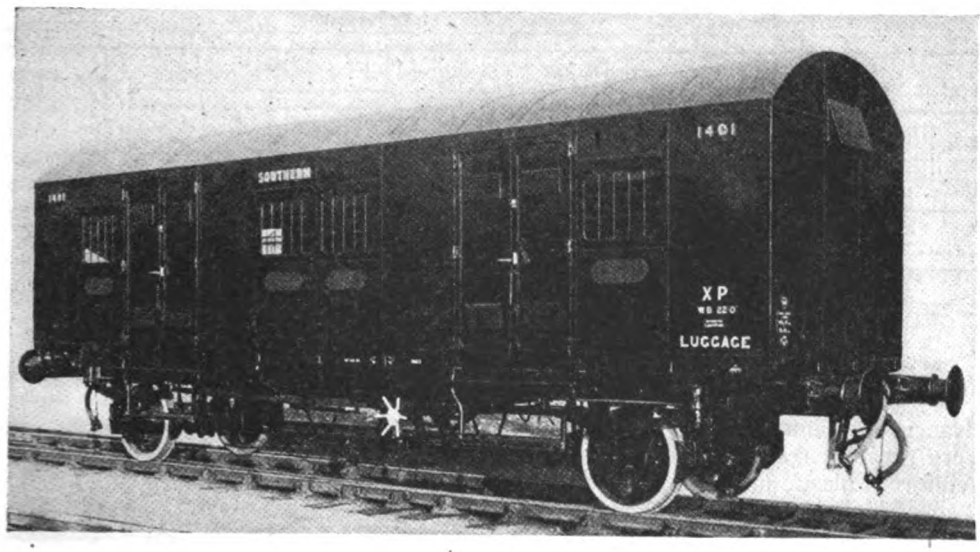
Fig. 5 gives a series of readings taken with the dryer discharge system shut off, thus showing what can occur if no steps are taken to control the carry-over into the dry pipe. As before, the test was started by increasing the rate of evaporation suddenly. The temperature of the steam leaving the No. 1 shape unit dropped to boiler saturation temperature and there was a considerable drop in the steam-pipe temperature. Both calorimeters show moisture in the dry pipe. After 9 min. the observations indicated that the carry-over decreased. This was probably due to the fact that concentration of both dissolved and suspended solids in the boiler had been reduced by the amount carried away. At 18 min. the carry-over became worse again.

The next series of tests was made with the dryer discharge system both turned on and shut off for practically continuous locomotive operation. The test was started with the discharge system shut off, and a foaming condition was created by increasing the exhaust pressure from 10 to 20 lb. per sq. in. Considerable carry-over immediately resulted. The steam-temperature and calorimeter readings show the same alternations in severity of carry-over as pointed out for Fig. 5. At 20 min. the dryer discharge system was turned on. Five minutes later both calorimeters indicated zero moisture and both steam temperatures were together at 675 deg. F. With such readings, it must be assumed that the steam in the dry pipe was practically dry. The dryer discharge valve continued to blow intermittently showing that carry-over into the dryer was still occurring. The train then went through a siding slowly but did not actually stop. After getting back to the main line, readings were continued with the dryer discharge system shut off. With 18 lb. per sq. in. exhaust pressure, the steam-temperature and calorimeter readings show a severe carry-over. At 60 min. of the test, when both steam temperatures were at the boiler saturation temperature, the dryer discharge system was turned on. The steam temperatures immediately started to increase and moistures indicated by the calorimeters approached zero. At the end of 62 min. the engine came to a stop and the test was ended.

All during these tests, the observations made through the sight glasses were interesting. At the very beginning with good water in the boiler, the surface of the water appeared relatively clear. Later, when the water was in a foaming condition, the surface of the water would usually appear to be a grayish color. When in this condition, an increase in the rate of evaporation would cause the foam level to rise and, when it approached the entrance to the dome, the steam would carry it up so that the dome would be entirely filled.

It is possible for carry-over to be sufficiently severe for the engine crew to notice it, as for the conditions illustrated in Fig. 3. Frequently, carry-over is taking place with no indications to the engine crew. Figs. 4 and 5 do not show any change in the water level that can be attributed to anything but the normal variations obtained due to track conditions and operation of the boiler feed pump. The condition of the water in the glass during these tests was good at all times. In spite of this, the readings proved that sufficient carry-over was taking place to impair the efficiency of the locomotive and, in time, to result in the failure of superheater units.

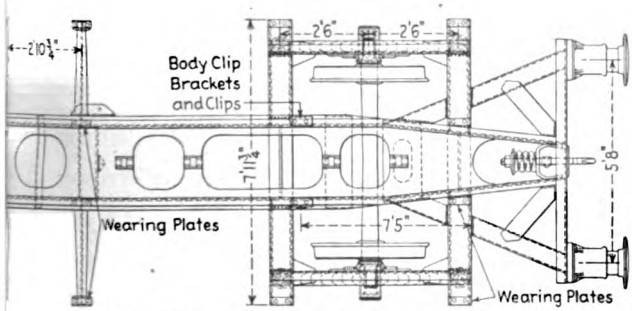
Plastics for Car Building



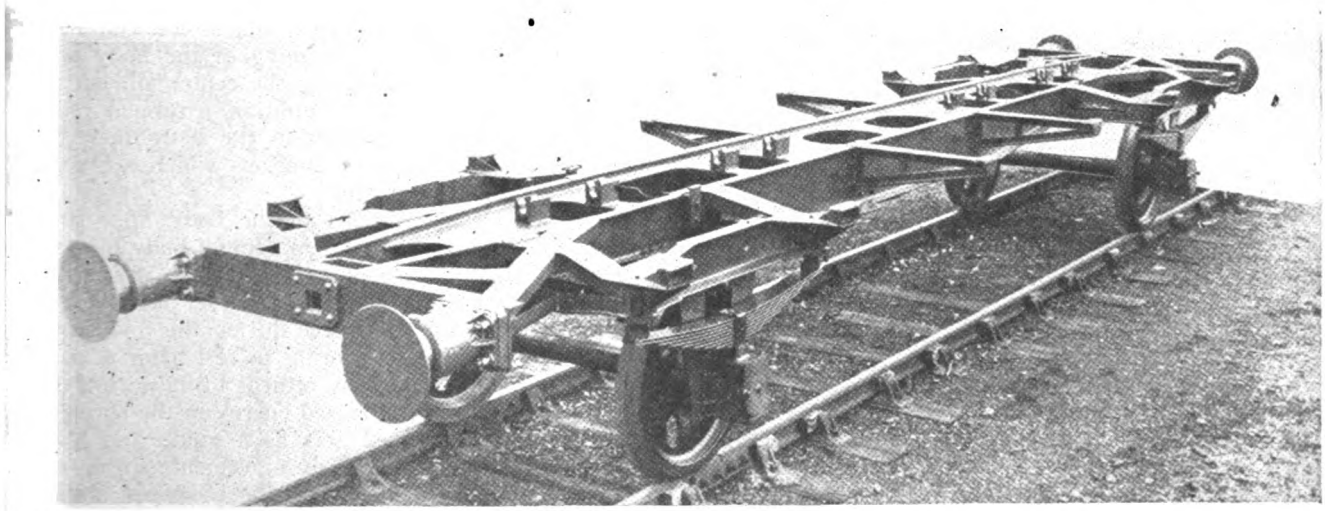
Southern Railway of England uses plastic-impregnated wire mesh for sides, ends and roofs of baggage cars – Spring cushioning of car body is an additional innovation

THE Southern Railway of England has placed in service in the past year ten four-wheel long wheel-base express cars in which the side, end and roof sheets were formed of reinforced wire mesh plastic panels. These cars also represent a departure in design in that they are spring-cushioned. The cars are used for all types of traffic and are designed to run in passenger trains at high speeds.

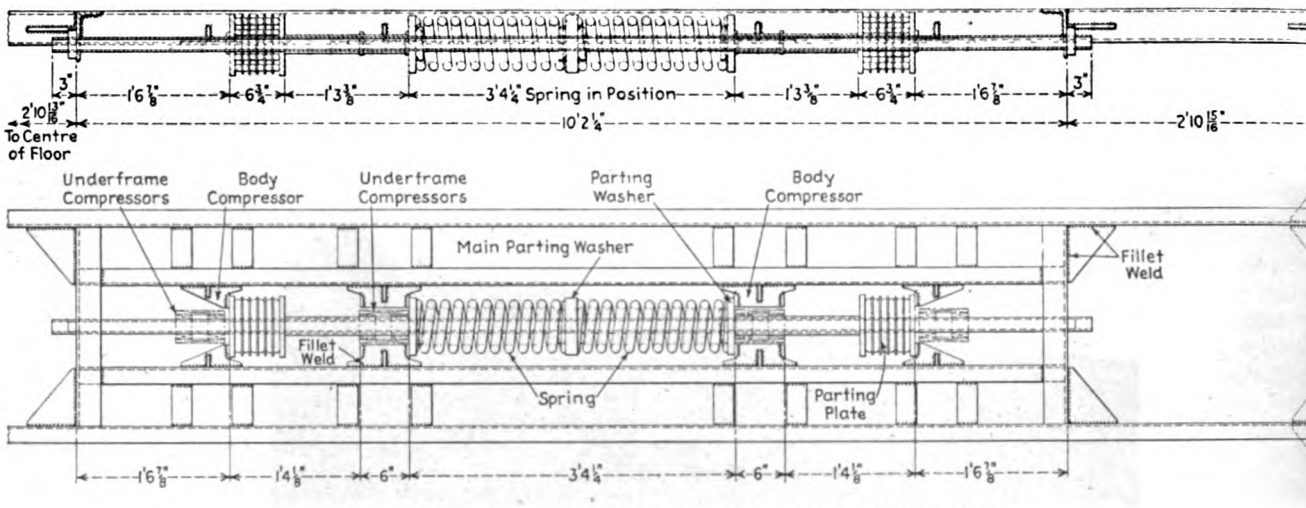
According to O. V. Bulleid, chief mechanical engineer, the following considerations were taken into account in designing the cars: reduced weight consistent with strength; avoidance of sudden shock to passengers or lading; use of new materials such as plastics where possible; following of latest methods of fabrication; and, assurance that maintenance costs would not be increased.



Plan view of one end of the underframe



Underframe of the spring-cushioned English car—The U-shaped brackets on the center sill serve as stops to limit longitudinal movement against the springs



Car-body floor construction showing arrangement of cushioning springs

Because the advances in manufacture of plastic materials have been very great in recent years, the railroad chose a form of reinforced plastic in which the reinforcement consisted of woven high-tensile steel wire and cotton mesh. The impregnating material is a phenol resin. The impregnated sheet is placed between two other sheets of ordinary impregnated material and the three layers pressed into a single sheet between steam-heated platens at a temperature of about 160 deg. C. and a pressure of one (British) ton per sq. in. War conditions dictated the use of black sheets but any color can be used. The sheets are impervious to attack by acid or atmospheric conditions, which prevents fading or other discoloration.

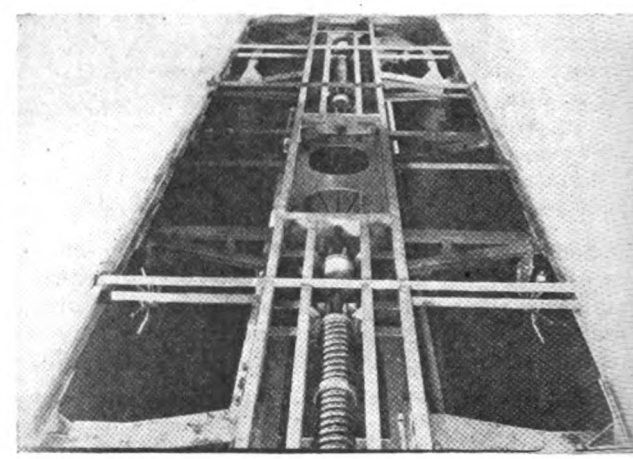
Press limitations required the use of sheets no larger than 6-ft. 6-in. by 3-ft. 3-in. and the car-body design was affected accordingly. The light weight of the material, 11½ oz. per sq. ft., was largely responsible for the adoption of the other innovation in design, spring-cushioning. Because of the lack of experience with the use of plastic structural materials it was felt desirable to protect the body and lading as much as possible from shock. A convenient way to do this was to separate the body from the main frame and introduce a form of spring-cushioning device similar to some which had been used with good results on English open-top and house-type cars.

The car body framing is generally of light channel sections, 2½ in. by 1¼ in. of 12-gauge steel, electrically welded in a jig. The floor framing of the body is of rolled channel sections with dimensions of 4 in. by 2 in. The carlines are made of laminated ash, shaped and bolted to brackets which are welded to the top side rail of the body. The plastic panels are held in place with screws which were driven into furring strips fitted into the channel sections of the body framing. They are prevented from working by a supporting strip fastened along their lower edges. Each joint is covered with a molding strip which was also screwed into the furring. A bitumastic compound was used to coat the panels and molding strips at the joints.

The sides and ends on the interior are finished with 3½-in. by ½-in. lining. The flooring is of grooved oak

General Dimensions and Weights of Baggage Car With Plastic Panels

Length over buffers, ft.-in.	36— 5
Wheelbase, ft.-in.	22— 0
Length over end sills, ft.-in.	33— 0
Length of car body, ft.-in.	32— 2¾
Width of car body, ft.-in.	8— 2⅜
Width inside, ft.-in.	7—11
Height, rail to top of roof, ft.-in.	12— 4 13/16
Weight of underframe, lb.	5,348
Weight of body, lb.	3,080



Floor framing of the car body in position on the underframe

1¼ in. thick with loose tongues set in creosote. Th doors are of light sheet steel.

The center longitudinal members of the floor framin form a cradle in which the springs of the body cushion ing gear are held. The center sill is of the cantileve type built up of plate and sections welded together. Th end sills are welded to the diagonal braces and buffin shocks are transmitted through these braces to the cente sill. All pulling forces are exerted directly on the cente sill. Clips on the floor framing of the body permit i to move longitudinally along the center sill but preven any lateral movement. In addition, a tubular rod whic passes through the springs in the body floor framin travels through U-shaped brackets which are welded t the center sill cover plate.

All springs are carried in the body floor structure They are arranged in tandem. Initial body movement i taken by steel coil springs. When these are partly com pressed a part of the load passes to a set of rubber springs These give a high resistance during the final movemen of the body which they bring to rest after a maximum travel of 11 in. The body returns to its normal positio by the exertion of the stored energy in the springs. Th tubular rod mentioned acts as a guide and holds th spring assembly during body movement; spring washer on the rod make contact with the U-shaped brackets o the center sill which serve both as guides and stops.

(Continued on page 60)

Diesel Mechanical Repairs*

By P. H. Hatch†

The Diesel engines, accessories and the equipment of the locomotive itself require a well-planned maintenance system and adequate facilities

THE Diesel engine or engines of a Diesel-electric locomotive are the principal problem in considering general repairs to the mechanical portion of the locomotive. As to the detailed procedure which is best to follow for any given make of engine the manufacturers' instructions should govern, at least until methods and programs based on experience are thoroughly worked out. Regardless of the make or type of locomotive Diesel engines, however, certain general considerations have a bearing on the matter. The most important of these and the one which is fundamental is that maintenance must be on the basis of preventive attention at definite intervals of service, i.e., miles in the case of road locomotives and miles or service hours in the case of switchers.

Whether or not a given type of repair is handled all at once at extended intervals or progressively during such intervals depends on the design of the engine and the maintenance policy of the railroad. Cases in point are cylinder heads, pistons, liners, water pumps, bearings and other parts subject to unit replacement, which may be taken care of in conjunction with other repairs of a general or classified nature or done progressively during layovers or at other convenient opportunities during service. Since in either case methods employed are generally similar, it will be assumed, herein, for the sake of convenience, that all repairs are concentrated in a single, simultaneous program.

Diesel engine repairs, therefore, will be along the following lines:

(a) Remove cylinder heads, dismantle and clean; re-face valve seats or if worn to limit install new inserts or weld in new seats, preferably of specially hardened material, and grind to contour; grind valves and if stems are worn sufficiently to require attention, re-plate to original diameter or turn down to an undersize dimention and use special valve guides; renew or build up and remachine valve guides; inspect valve levers, springs, spring retainers, bushings, etc.; check gaskets, or seal surface.

(b) Remove pistons and dismantle from rods; take out and discard rings, thoroughly clean all parts and inspect for cracks and worn grooves; if grooves are worn excessively, machine for oversize rings (if a satisfactory method has been developed, machine out worn grooves, weld in replacement material and re-machine grooves to standard dimensions); install all new piston rings; inspect pins or attachments to rods.

(c) Inspect cylinder liners or sleeves and replace if necessary; remove any ridge appearing at top of ring travel; if necessary, lightly hone interior surface for quick seating of new rings; check gasket or seal surface and install all new seal rings if liner is removed.

(d) Inspect connecting rods and check for straightness and parallelism; magnaflux for detection of cracks; clean out oil passages; inspect, repair or replace big-end bearing shells, re-installing with proper clearance.

(e) Inspect, repair or replace main bearing shells and note condition of journals; check crankshaft with dial indicator at each throw for distortion; inspect each pin for condition of surface and measure for out-of-round, blow-out or clean oil passages; clean entire crankcase interior thoroughly. (If pins or journals are badly worn or are scored, it may be possible to restore them to standard conditions or dimensions by machining, metal spraying and grinding; this will, of course, involve removal of the shaft from the engine in which case detailed inspection, including magnetic test can be made. If wear or scoring has taken place to a point under the minimum allowable diameter, then the shaft must be replaced.)

(f) Inspect gear train or trains as far as possible and check for backlash; if the crankshaft must be removed, then more detailed check can be made together with necessary repairs or replacements, such work including camshaft bearings and cams, cam followers, push rods, etc.

(g) Remove and dismantle supercharger or blower for inspection, cleaning and necessary repairs; inspect blower drive and make any repairs necessary; clean air intakes and air passages, cleaning or renewing all filter elements; inspect exhaust piping and muffler and clean.

(h) If required as result of service, experience, remove, dismantle and repair lubricating oil pumps and inspect drives; remove and clean all lubricating oil piping and clean or renew filter elements on engine; renew flexible hose connections; check setting of regulating valve.

(i) Remove; dismantle and inspect water pumps and check drives; check and clean all water piping on engine and renew flexible hose connections.

(j) Remove governor; inspect drive and install reconditioned and readjusted unit; remove throttle operator; clean and repair; check all linkages; inspect overspeed shut down device.

(k) Remove all fuel injection equipment (nozzles, high pressure pumps, injectors) and install new or factory reconditioned units; check over high and low pressure piping on engine and inspect fittings and clamping; clean or renew all filter elements; inspect fuel pump drive assembly or injector cams and levers and make necessary repairs or renewals.

(l) Remove water and oil radiators, clean thoroughly and test; remove heat exchanger, clean and test; remove locomotive lubricating oil piping and clean; clean or renew locomotive filter elements; remove and clean all regulating or relief valves and adjust for proper settings; clean interior of expansion tank and paint with special mixture; clean locomotive cooling water piping.

* This is the second of three articles discussing general and running repair facilities for Diesel locomotives. The third will appear in a subsequent issue.

† General mechanical superintendent, New York, New Haven & Hartford, New Haven, Conn.

(m) Inspect and make necessary repairs to radiator fan and drive, including pulleys, idlers, belts, gear box, angle drive and fan; inspect radiator, shutters, operating mechanisms, etc., clean fan; fan housing, shutters, etc., to remove surface dirt.

(n) Remove, inspect, clean and calibrate all indicating or contact making gauges including fuel and water tank level indicators.

(o) Inspect fuel transfer pump and motor and make necessary repairs or replace with reconditioned unit; clean and adjust pressure regulating valve; clean or renew all strainer elements.

(p) Drain fuel tank, flush and clean.

(q) Reassemble engine restoring clearances and fits to manufacturer's tolerances and standards as closely as possible. It is not good practice to be economical with gaskets or seals—install new wherever disturbed or where it is known deterioration takes place. Tighten but do not over-tighten bolts and nuts and check them for tightness after the engine has been run for a while. Use new or reclaimed crankcan oil. Run in thoroughly and load test as described later.

From the outline just given, one fact is of immediate importance from the standpoint of shop schedule and production. This is the beneficial result to be obtained from a stock of complete spare units of Diesel engine equipment to replace similar units coming in on an engine and which will require repairs or reconditioning. This serves the double purpose (1) of preventing delay in reassembly of an engine while waiting for repairs to be completed on individual parts and (2) of allowing the different classes of repairs to be segregated and handled by specialized groups in the shop. This, in turn, permits quantity production methods to be employed as far as possible, depending on the total number of locomotives involved. For example, one gang can be assigned all cylinder head work and making use of spares, can have a completely reconditioned set of heads ready the minute each engine is at the point where heads are required. The heads which were removed from the engine can be given the necessary attention and made ready for the next assembly and so on. If by any chance more than normal repairs are required on any head or a set of heads, these can be handled without delaying the engine, on which they came in. Applying this same procedure to fuel injection equipment, governors, pistons and rods, etc., all important categories of parts of Diesel engines can be handled in the quickest possible time which will be reflected in less out-of-service time for the locomotive and less over all cost of maintenance.

It can readily be seen that if this method is adopted, it will not be long before no engine will have its own quota of original parts. This imposes a duty on the part of the shop to keep complete and accurate records of all change-outs, which in turn, requires serializing of all interchangeable parts. This will not present any serious problem, for the application of serial numbers is standard practice with the manufacturers and in those cases where serial numbers may not have been applied it is easy for the railroad to do so.

Some railroads engaged in the intensive use of a considerable number of Diesel-electric locomotives have gone so far as to purchase complete spare Diesel engine generator sets to permit lifting out power plants in for repairs and replacing them with complete reconditioned sets. While this may be rather expensive in first cost, it pays the maximum in benefits because very considerable time saving for the entire locomotive results and engine rebuilding can be handled most efficiently. It also offers a high degree of protection in cases of casualties in service requiring engine rebuilding.

In concluding the remarks on Diesel engine repairs, one fact cannot be over-stressed. This is adequate running in and breaking in before releasing for service. Time, fuel and labor spent in this will be amply repaid. Combined with this should be determination of compression and ignition pressures in each cylinder, exhaust gas temperature for each and the noting of engine speeds, lubricating oil pressures and temperatures, cooling water temperatures, supercharger or blower pressures, horsepower output under varying conditions of current and voltage, as indicated by the main generator characteristic curve, individual notch speeds and loading, color and quality of exhaust, general sound and action of the engine under load and acceleration, and so on. The facilities for this have already been listed and include a water rheostat or resistor bank for loading, cylinder pressure indicator either of the maximum instantaneous pressure or the curve drawing type, pyrometer and thermocouples, voltmeter and ammeter with shunt and the usual complement of pressure gauges, thermometers and temperature indicators which are a part of the regular engine equipment.

Preparatory to applying full load to an engine the following procedure has been found to be satisfactory in the case of one make and type of Diesel engine:

(a) After first starting the engine and while idling to determine that conditions are normal in all respects including proper connecting rod and main bearing temperatures, idle for eight hours if main bearings have not been disturbed or for 16 hours if the main bearings have been removed or replaced. General watch should be kept of the engine during this time and checks of bearing conditions should be made at increasing intervals during the eight or 16 hours.

(b) After the idling is completed, load the engine to the proper degree and run for 35 min. in each notch until the highest is reached, after which the full load testing can be completed in accordance with requirements.

(c) After the load testing is completed, check over all accessible bolts and nuts on the engine for tightness and change crackcase oil.

When considering the mechanical parts of the locomotive, the one next related to the Diesel engine is the air compressor. On the majority of locomotives this is usually belt driven from the Diesel engine or it may be mounted on the engine and direct connected to it. In any event, Diesel engine repairs of the type described should be accompanied by similar repairs to the air compressor which will consist principally of thorough cleaning, reringing of high- and low-pressure pistons, renewal of valves including unloader valves, etc. Bearings should, of course, be inspected and replaced if necessary; unless bearing trouble has been experienced the crankshaft will require little or no attention for extended periods.

If the locomotive is equipped with train heating boiler either it should be replaced with a re-conditioned unit or it should be given attention to put it in first-class shape for the next period of operation. Such attention will consist in general of removal of coils for cleaning, testing and replacement if necessary; the burner element should be removed and reconditioned and the firebox section renewed; the steam separator and water treatment tank should be cleaned; such items of auxiliary equipment as the main driving motor, fan, belts, feedwater pump, fuel pump and the various control switches, relays, protective devices, etc., should be removed for cleaning, repairs, calibration or adjustment or replaced with

(Continued on page 65)

OVER THE HILL WITH A DIESEL

By Walt Wyre

Part 1

NED SPARKS, electrician for the S. P. & W. at Plainville, walked the length of the powerful four-unit Diesel electric freight locomotive that stood on the full track about two hundred yards from the roundhouse. Resplendent with its bright colors and decorative stripes, the 5400 horsepower locomotive stood alone as though disdaining to associate with the steam locomotives being serviced in the roundhouse.

"Pretty, isn't she?" Jim Evans, the roundhouse foreman, remarked to Sparks.

"Sure is," Sparks agreed, "and pretty isn't all. I'll bet she can make passenger train time with a hundred loads from here to Sanford."

"That's right," Evans cocked his head to one side and eyed the locomotive, "but I wonder how she will perform on the Mountain Division."

"Why, I thought they were going to use the Diesels on the Plains Division!" Sparks said.

"They are," Evans nodded, "but the present plan calls for running them over the Mountain Division, too. They are to run from here to Sanford, then over the Mountain Division by way of Hillside to Altus and return."

"Lots of sharp curves and tunnels on that route," Sparks commented. "Wonder how many cars a Diesel will handle up the hill from Altus to Hillside?"

While the two were pondering the problem, H. H. Carter, the master mechanic, accompanied by road foreman Tom Price and a stranger, came up. Carter introduced the stranger to Evans and Sparks as Wallace, an expert from the Diesel-electric factory.

Wallace shook hands. "My first name is Sam," he said. "That's what everybody calls me and I haven't got time to get accustomed being called Mister."

"Glad to know you, Sam. Sometime when you are not too busy, I would like to ask a lot of questions about Diesel-electrics."

Sparks started to leave when the master mechanic stopped him. "Just a minute, Sparks. You may have a chance to learn about freight Diesels sooner than you think."

"I understand you have had considerable experience on passenger Diesels," Sam said.

"Oh, not a lot," Sparks replied. "I have done some work on them."

"How would you like to be a traveling Diesel electric maintainer?" Carter asked. Then before Sparks could reply, the master mechanic added, "You see, we plan to put maintainers on the freight locomotives, perhaps temporarily, maybe permanently, that remains to be determined. The jobs will be bulletined. In the meantime if you are to start breaking in on it you can go out tomorrow. Mr. Wallace will be with you to explain anything you don't understand and tell you what to do."

"O. K.," Sparks agreed, "I would like to try it a while, anyway."

"We may have quite a few 'bugs' to work out on the first trip," Wallace said. "Hope they don't hang too much train on going up the hill."

"What time will we get out?" Sparks asked.

"Sometime around six or seven o'clock in the morning," Carter replied. "I'll tell the engine dispatcher to call you when he calls the engine crew."

SPARKS was sleeping peacefully when the phone rang at 5:30 next morning. He reached for the alarm clock to shut it off. His wife nudged him in the ribs with her elbow. "The phone is ringing," she said.

"Uh-huh," Sparks mumbled, and turned over.

"Go answer the phone," Mrs. Sparks nudged again and harder.

"Wonder who is calling this time of night," Sparks growled. Then he remembered.

"Called for 7:00, extra 900 west," the dispatcher said. Sparks repeated the call and replaced the receiver.

Wallace was waiting at the roundhouse when Sparks arrived about six-thirty. "Better check the oil, water, and fuel," Wallace suggested, "I'm certain it was supplied yesterday, but it's a good idea to get into the habit of checking. While you are doing that, I'll start the engines and let them be warming up."

The engineer, Ed Holcomb, had run passenger Diesels; the fireman, Dan Walters, was new on the job. "What am I supposed to do?" he asked Wallace.

"Watch the engine temperature and keep it as near 165 degrees as you can," Wallace told him. "While the engineer is waiting for orders, I'll show you about handling the fans and shutters to regulate the temperature."

Sparks, who had finished checking the supplies and had come into the cab, followed Wallace and the fireman into the engine room.

"It's fairly warm this morning and I have an idea it's going to get really hot in about three hours, so you will need both fans in, and my guess is two shutters about half open to start. You can see the temperature is only 135 now," Wallace pointed to the gauge on the water tank, "and we will leave the fans out and shutters closed until the engineer couples on the train. By that time I have an idea the temperature will be up around 160. It's not a good idea to work the engines very hard when they are any cooler than that and, as I said before, around 165 degrees is best."

The engineer interrupted the conversation with two short toots of the whistle. "You and Sparks kick the fans in like this,"—Wallace placed his foot on the clutch lever and shoved gradually—"and don't ever put the clutch in with the engine running faster than idling," he cautioned.

THE electrician and the fireman started through the engine rooms. Wallace stepped up into the cab and told the hogger that when all fans were in he would signal by ringing the attendant's call bell twice. He then turned and followed the electrician and fireman, checking lubricating oil, pressure gauges, and fuel oil sight glasses as he went.

They found a train of eighty-seven loads waiting on No. 5 track. By the time the air test was made the engine temperature had climbed to almost 160 degrees.

"Is there a stretch of level or down-grade between here and Sanford?" Wallace asked the engineer.

"Yes," the hogger replied, "right after we cross Clear Creek it's uphill about six miles, then the only up-grade for the next thirty miles is this side of Middleton and doesn't amount to much."

"Well, I guess we can cut an engine out along there," Wallace said to Sparks, "and I'll show you about making an inspection—inspecting crank case mechanism, cleaning and inspecting the air box and inspecting valve and injector rack mechanism; also, the timing will be part of the maintainer's job," Wallace explained. "You see, that will materially reduce terminal time required for inspecting and servicing."

"What about electrical inspection?" Sparks asked.

"Oh, yes, we have a regular routine worked out. The Diesel supervisor has been working with us several weeks." Wallace pulled a long mimeographed sheet from his pocket. "You see, the ones marked with an X will be done by maintainers. Take this and look it over."

"High ball!" the hogger said as he acknowledged the conductor's signal to start.

"Don't be in too much rush about starting," Wallace cautioned the engineer, "unless you want to pull out a drawbar. Give the air plenty of time to release."

The powerful locomotive started the train with little effort and it was soon rolling out the lead to the main line. The engineer held the speed down to fifteen miles an hour until the train was on the main track, then began to notch the throttle back.

"NOW let's go through and see if all of the contacts are closing and engines loading properly," Wallace said to Sparks. "Better check temperatures," he advised the fireman.

Everything was O.K. until Sparks and Wallace reached the No. 3 unit. The throttle was in the eighth position but the load indicator was only on the sixth. Wallace pointed and yelling in Spark's ear called his attention to the discrepancy. Sparks saw the indicator but the roar of the Diesel drowned the words.

Wallace went to the high voltage cabinet, Sparks following. The engineer was operating with the transition lever in No. 2 position (series-parallel-shunt). The motor field shunting contactors on that unit were not closing. Wallace found a flag stick with which he pushed lightly on the series contactor interlocks. The "M" contactors closed and the load indicator climbed to eight. The two men walked to the rear cab.

"It's always a good idea to check all contactors and engine loading when leaving the terminal," Wallace explained to Sparks. "We'll clean that interlock with a piece of crocus cloth soon as we get a chance to take the engine off the line and kill it. Don't start poking your fingers around the contactors when the engine is running; might get one burned off," he added.

They sat in the cab and talked a few minutes, Wallace explaining operation of the transition meter and its relation to the various speeds. "The transition meter is simply an ammeter," he pointed out, "and instead of being calibrated in amperes, is marked off to show shifting positions. Makes it more simple for engineers to understand. You might take a walk through the engine rooms and see how everything looks," he added.

When Sparks started to look at the engines the train was on a slight down grade towards Clear Creek bottom. In a few minutes he returned. "Say, none of the load indicators show as high as the throttle indicator."

Wallace glanced at the speed indicator, then at the transition meter before replying. "That's O.K. However, it wouldn't hurt for the engineer to close the throttle a couple of notches. You see, the load regulator has reduced the main generator field, thus cutting down the load on the engines."

GOING through Clear Creek bottom they ran into a rain, not heavy, but enough to wet everything. There was a twenty-mile-an-hour slow order over the bridge and a fairly steep grade coming up out of the bottom. Approaching the bridge, the engineer closed the throttle and made an application with the automatic brake valve. Evidently the hogger put more air under the train than he had intended. By the time the caboose reached the bridge, speed had dropped to between 10 and 12 m.p.h.

"He may have a little trouble if the grade is heavy as I think," Wallace observed as he watched the speed indicator.

The transition meter needle swung to the right, showing increased traction motor current. The wheel slip indicator light flashed on and off a couple of times. Gradually the speed increased until the train was going about fifteen miles an hour. The wheel slip indicator light flashed on several times, the train started losing speed. Wallace rose from his seat to start towards the front end of the engine. Just as he reached for the door latch, the alarm bell started ringing.

"I was afraid of that," Wallace said. "An overspeed trip has operated and killed an engine. Let's see which one it is." He started through the engine rooms closely followed by Sparks. "Here it is," Wallace announced as they entered the engine room of the No. 2 unit.

Sparks watched as Wallace latched the overspeed trip, then turned the isolation switch to start position, cutting the engine off the line, and pressed the starting button. When the engine had started, Sparks reached for the handle of the isolation switch.

"No!" Wallace caught Sparks by the arm, then took hold of the lay shaft lever. "Now throw it on the line." Wallace held the lay shaft lever and allowed the engine to pick up speed gradually until it was carrying a full share of the load, then released the lever and went to the front engine room. They met the fireman who hearing the bell was looking for a hot engine.

"SEEMS like she's not pulling so well," the engineer said when Wallace and Sparks entered the cab.

"It's doing O.K. now," Wallace replied. "The No. 2 engine slipped her wheels and the overspeed trip kicked out. Just take it easy, let her pick up gradually. Slip a little sand under her—not much."

"How did you know it was an overspeed trip?" Sparks asked.

"Well, the circumstances indicated that to be the trouble. The engines working full throttle and slipping occasionally, that's what usually causes an overspeed trip to operate."

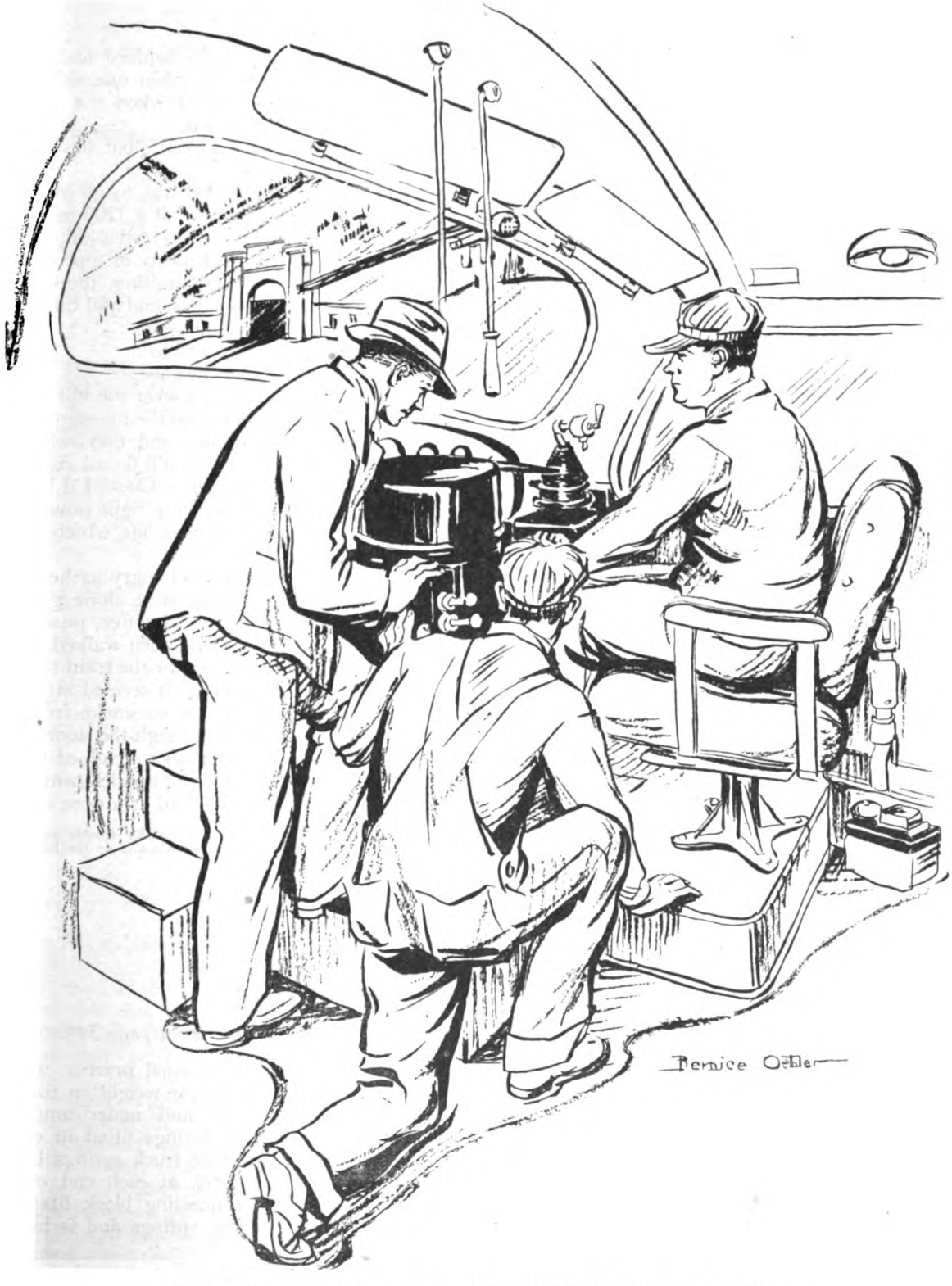
They had no more trouble going up the hill and would have had none in the first place if the engineer had not tried to pick up speed too rapidly on the slick rails. By

the time the train topped the grade it was rolling along nearly twenty miles an hour and picking up all the time. There was a slight up-grade about two miles more, then the level stretch that the hogger had mentioned.

Wallace and Sparks rode the front cab until they were almost to the level track, then Wallace said, "Guess we might as well make an inspection on the rear unit. It won't take long with two of us doing it."

The two men went to the tool cabinet in No. 2 unit. "What tools will we need?" Sparks asked.

"Well, about all is a wrench to fit the inspection plate nuts," Wallace told him. "When we get back to Plainville, I'll have a bar made and an eye bolt welded to the floor in each engine room so we can use a Coffing hoist to turn the engine. One man alone can't get along very well barring the engine over by hand and it's almost im-



The transition meter is simply an ammeter marked off to show shifting positions

possible to check injector and exhaust valve timing that way. These are the gauges to check timing,"—Wallace picked up a small box and handed to Sparks who opened the box and saw a thickness gauge which was just a flat piece of polished steel and a short polished rod, one end turned smaller with a shoulder. "Bring them along, I'll show you how they are used."

"Want to kill the engine now?" Sparks asked when they had walked to the rear unit.

"Not yet," Wallace said. "Let's lift the covers off the top and look at the upper mechanism while it's running. Take her off the line first," Wallace cautioned. "You might get an oil bath if you don't. Put the isolation switch in start position, then in case the engineer opens the throttle it won't affect this engine, it will continue to run at idle."

Wallace lifted a section of the top cover from the engine and hung it on an inspection plate hand wheel. Sparks did the same until the four covers on one side were removed. "Now let's look them over. Look for loose oil pipes, loose crab nuts, head bolts, injection leakage, broken valve springs, in fact everything that could cause trouble, and, oh yes," Wallace added, "while the covers are off, it's a good idea to see if the lower exhaust stack bolts need tightening. They sometimes work loose from expansion and contraction, then if they get to leaking a gasket may be blown out."

Just as Wallace had suggested, they found several stack bolts loose on that side of the engine. In fact, two nuts had worked entirely off and were lying on top of the web between the cylinder banks. No other trouble was found on that side. It was the same on the other side except that one of the small oil pipes was slightly loose and might have caused trouble later on.

"Now we will make an air box inspection," Wallace said when the covers were replaced. "First, we will stop the engine then remove all the inspection plates. Take a rag and wipe oil off the inside of the plates and the bottom of the hole so it won't make a mess, and, oh yes, be sure and lay the covers in order so we can put them back where they came off, otherwise they might leak."

Sparks picked up the bar and started to attempt to turn the engine. "How much do you want it turned?"

"Not any yet, and it might be a good idea to open the relief cocks before you try to turn it. Here's the wrench." Wallace handed Sparks the small wrench. "Now," he explained, "let's look at all pistons. Got a flashlight?"

"Left mine in the rear cab," Sparks said. "I'll go get it."

"Never mind, I have one. Here's the idea of looking at all pistons," Wallace continued. "Two pistons will be on top center, the others will be in various positions. It's a good idea to make a pencil mark even with the ones that are on top center, then you can tell when you finish. Now we'll take the bar and turn the engine approximately 22½ degrees. If we were checking timing, it would have to be exact. That will bring two more pistons to top center. Then by the time we have finished we will have seen tops of pistons, cylinder walls, and the length of all pistons, at least on one side. Look for water, scored liners, stuck or broken rings, blow-by, and so on. Right now while the engine is new we are not likely to find any trouble."

Wallace was correct in his surmise. There wasn't any evidence of trouble and the fact was so indicated on the work report. They didn't make the crank case inspection because the train was approaching the grade leading in to Sanford by the time they had finished the air box inspection and replaced the covers. However, Wallace explained how it was done and to look for loose nuts inspect bearings, see that piston cooling oil pipes were in proper position, and so on.

When the engine was started, Sparks started to put it on the line as he had when the one had died. "Wait until the oil pressure builds up. How's the water temperature?"

"It's down a little below 160," Sparks replied.

"That'll be O. K.," Wallace said. "It will be warm by the time the engineer needs to work it hard. Don't ever let them work too cold. If you do, you are headed for trouble, especially water leaks."

THE run from Plainville to Sanford had been made in good time. They had only taken one siding to let the Limited pass. It was 11:50 when the train stopped. "Let's eat," Sparks suggested.

"Good idea," Wallace agreed, "but first let's find out how much time we have."

They learned that the 900 was to go over the mountain by way of Hillside and pull a 3200-ton train with a steam Mallet helping to the top of the hill. It was called for 1:35 P.M., so they had plenty of time to eat.

While the two men were waiting, the call boy came into the eating house, looked around and came over. "Are you Sam Wallace?" the boy asked.

"That's right," Wallace nodded.

The boy handed him a message.

"Do you think you can get over the hill O.K. without me?" Sam asked when he read the message. "Two more Diesels are coming in today and they want me to go back to Plainville tonight. You'll do all right." Wallace laid his hand on Sparks' arm. "Guess I'd better eat in a hurry, the passenger is due here right now."

The train was a few minutes late which allowed Sam time to finish.

Sparks somehow wasn't as hungry as he had been before he learned that he was to be alone going over the hill. He drank a second cup of coffee, pushed the soggy pudding aside, paid the clerk, then walked out to where the 900 was standing waiting for the train to be made up. As he approached the Diesel, it seemed strangely silent. He walked faster. There was no smoke from any of the exhausts. Sparks climbed through the door into the No. 2 unit. The engine was dead as were all of the rest. The passenger train tooted twice and pulled out. Sparks was alone with the big Diesel—dead as a door nail.

[Part II of this article will tell of Sparks' trouble getting started and taking the heavy train through the tunnels and up the hill.—Editor.]

Plastics for Car Building

(*Continued from page 54*)

Another departure from usual practice was made in the method of carrying the car weight on the axle. The weight of the car body and underframe is passed through volute auxiliary springs fitted in cups on the side sills to the semi-elliptic truck springs by means of a separate connecting block at each end of the semi-elliptic spring. This connecting block fits in recesses provided in both types of springs and is held in place by collars.

The cars are equipped with vacuum-type brakes and a hand brake. The wheel diameter is 37 in. and the journals 4¼ in. by 9 in.

Fireboxes and Staybolts

[THE two papers of which abstracts follow were prepared by the authors as members of the 1944 committee of the Master Boiler Makers' Association which engaged in the study of the application of staybolts and the service obtained from various methods, styles and materials. The report of this committee appeared in the November, 1944, issue of the *Railway Mechanical Engineer,* page 502.—EDITOR.]

Locomotive Firebox Failures

By D. R. CARSE

Climax Molybdenum Company

Firebox sheets fail from three principal causes: cracking on both the fire side and water side, corrugations and overheating, and corrosion. Probably the chief cause of firecracking is the effect of decarburization on the surface of the firebox sheets, where the stresses are highest (see Fig. 1). This decarburized skin has a lowered tensile strength which may drop to as little as 10,000 lb. per sq. in. at the operating temperature, and certainly does not exceed 25,000 lb. per sq. in. When the sheet is heated, the fire-side surface is placed in compression and must upset since it expands more than the interior of the sheet which is cooled by the water. Correspondingly, on cooling, this fire-side skin is placed in tension. Repetitions of this stress cycle may develop stresses in excess of the tensile strength of the decarburized surface, and hence cause cracks. The condition is further accentuated by the aging effect in certain steels resulting in lowered ductility in the interior of the sheets. This constitutes one of the principal arguments against rimmed steel, since it is always lower in carbon near the surface. Data on 50 locomotives, 25 of which had rimmed steel fireboxes while the other 25 were equipped with plain carbon killed steel, shows that all had approximately the same firebox life. It must be remembered that decarburization is usually present on all hot rolled sheets, yet all firebox sheets do not firecrack; the low tensile properties of the decarburized surface layer are simply less resistant to the stress cycle that produces firecracking. Cracks will not develop from this condition, however, unless the operating conditions are severe enough to develop stresses in excess of the strength of the surface layer.

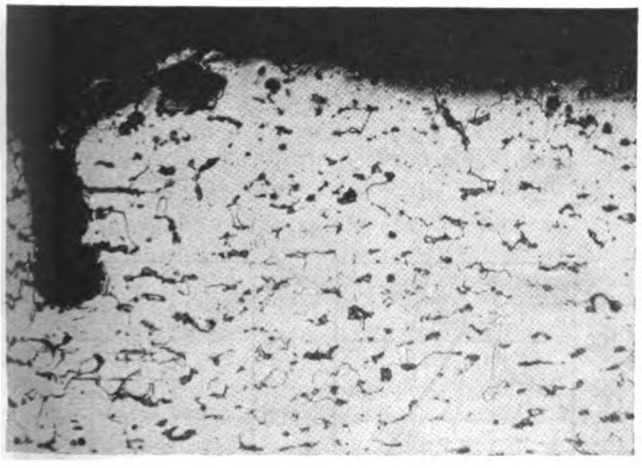


Fig. 1—Decarburization of fire-side surface of A.A.R. firebox steel (Magnification 250)

In this connection, definite issue is taken with the statement appearing in the 1943 Proceedings of the Master Boiler Makers' Association that "there is no record of an instance of sheets cracked on the fire side in the absence of leaky staybolts." Nor does a study of the subject bear out the theory advanced in that paper, that firecracking may be caused by a type of stress corrosion. There are many well substantiated instances where firecracks occur, with no evidence of any staybolt leaks whatsoever, and there are also cases of leaks caused entirely by a water condition and where no cracking occurred.

It has always been observed that firecracks follow the stress pattern and are concentrated around the staybolts, because these form the points of localized stress. Fig. 2 illustrates this clearly. The depth or rate of propagation of the cracks becomes greater as the stress pattern is intensified, and from Fig. 3 it will be seen that the depth is greatest at the point of restraint, which is that adjacent to the staybolt.

The action of the boiler water resulting from a leaky condition can accelerate the propagation of existing cracks through corrosion. This action occurs, however, only within the stress pattern. Leaking is not a direct cause of cracking, but an accompanying or secondary factor which may, or may not, occur coincident with it.

In exception to this contention, an eastern railroad cites two locomotives, one of which received special care in the staybolt installation, and the other of which was equipped with seal-welded staybolts. These locomotives had run approximately 100,000 and 75,000 miles respectively when reported upon and showed no leaky bolts

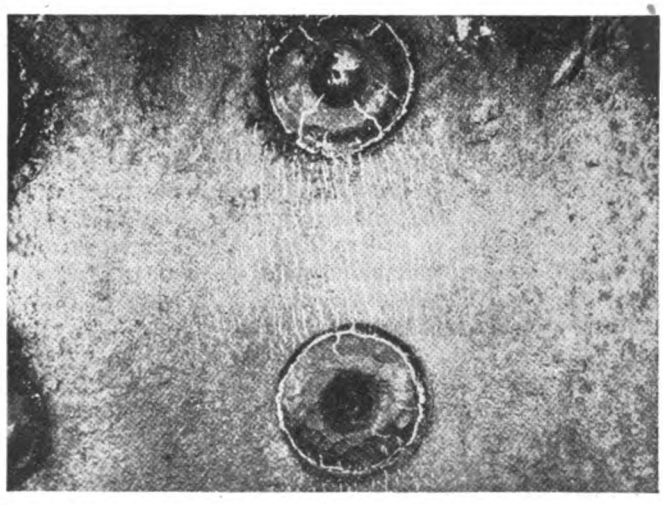


Fig. 2—Typical cracks around staybolts

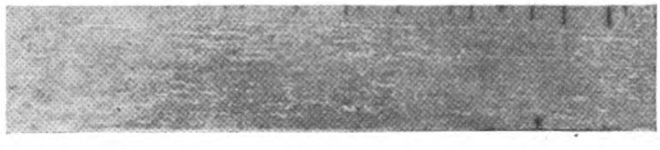


Fig. 3—Firecracks increase in depth as they approach staybolts

or firecracks. Other engines of the same type in the same service developed leaks after a much shorter life, and had to be returned to the shop for complete renewal of side sheets due to firecracking. The engineer of tests of this road reasonably asks, "The question is why did not all of these similar engines in similar service act the same way and sheets consistently crack or not crack. All we definitely know, is that the engines which have not had

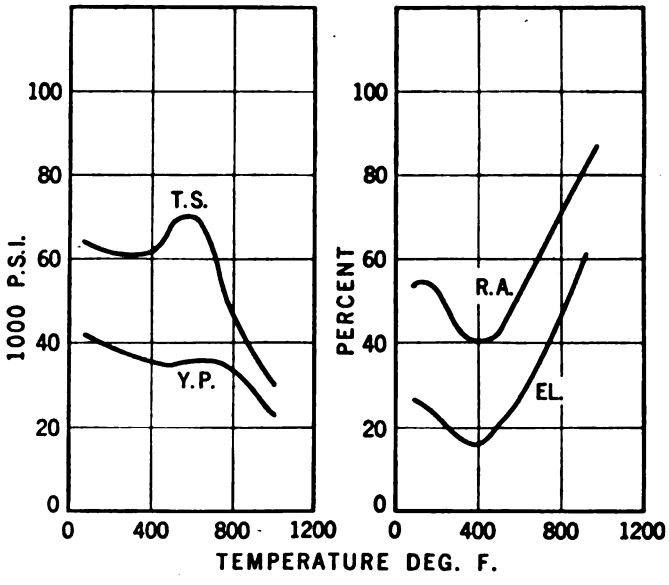


Fig. 4—Effect of temperature on the physical properties of standard firebox steel

leaky bolts have not cracked, and those which have leaked, developed cracks very quickly."

Should the experience on these locomotives be substantiated by other tests on seal welded stays where leaks are impossible, corrosion fatigue can be established as another cause of firecracking. The question is not whether leaks accelerate firecracking but whether they are the cause, since if cracks do not exist their progression cannot be accelerated. That laboratory investigation of fire-cracked sheets has at times shown no indication of any previous leakage, supports the author's original contention that leaks do not initiate cracks, but merely hasten their growth once started. The writer urges that a larger number of locomotives be equipped with plain carbon firebox sheets and plain carbon-steel or wrought-iron seal-welded staybolts, and that for these tests, locomotives be selected which are known to be subject to severe firecracking. This alone will determine whether seal welding is the answer to firecracking. The suggestion that both seal welding and alloy stays be employed defeats itself, for if the expense of seal welding is resorted to, there would be no need to use alloy.

R. Rennie of the American Locomotive Company also takes exception, and advances the theory that firecracks, at least in certain locomotives, may be attributed to sulphur contamination from the fuel. It is true that sulphur conditions are corrosive. If the surface of the steel has strain lines or stressed areas, then such lines or areas will be strain-corrosion etched. The net result would be acceleration of the typical cracking encountered, with sulphur acting as the accelerator, but not as the initial cause.

Metallurgical Approach

The metallurgical approach to the problem of firecracking is, consequently, to select an analysis containing an element which will strengthen the decarburized material, particularly at elevated temperatures. Molybdenum meets the needs in such service. Service tests over a period of many years have shown a life in carbon molybdenum firebox sheet of roughly three times that of a plain carbon sheet before firecracking develops to a point which necessitates replacement when all other factors are equal.

A. S. T. M. Specification A 204-42 covering a steel containing approximately 0.50 per cent molybdenum, is generally used for this purpose. Even though decarburized to a carbon content of only 0.03 per cent, this analysis would still have a tensile strength at operating temperature nearly twice that of standard firebox sheet decarburized to the same extent.

Tests conducted by the Battelle Memorial Institute clearly show the unique effect of molybdenum in maintaining the strength of ferrite at elevated temperatures in wrought irons. Figs. 6 and 7 give the results of these tests. At 1,000 deg. F. a wrought iron containing 0.50 per cent molybdenum with a 0.03 carbon content loses less than 37 per cent of its room temperature strength, whereas without molybdenum, a wrought iron of 0.04 per cent carbon content at the same temperature, loses more than 62 per cent of its room-temperature strength. A similar strengthening effect occurs when molybdenum is added to low-carbon steel. It should, however, be stressed that the use of any alloying element will not eliminate failures due to poor workmanship, faulty material, or sheets improperly rolled so that they lack good surface condition.

Cracking of sheets on the water side may be due to several factors. Chief among these probably is thermal shock, one of the most severe forms of which is caused by the impingement of cold water on hot sheets. This

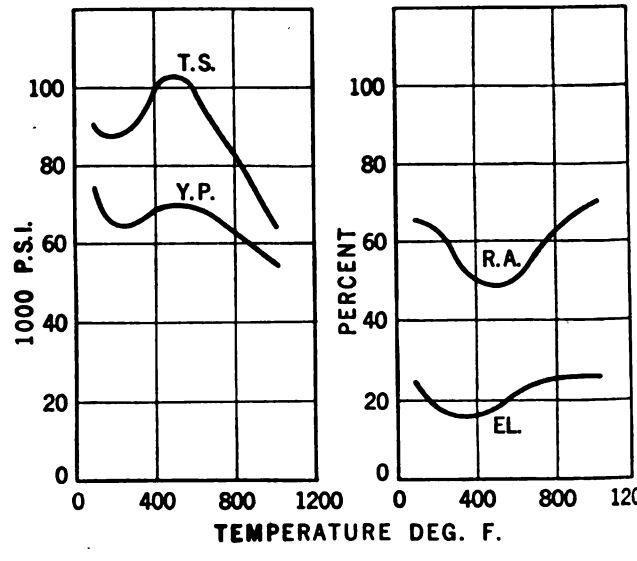


Fig. 5—Effect of temperature on the physical properties of a carbon-molybdenum firebox steel

may only be avoided by preheating all wash-out water and educating the crews to use the injector instead of the water pump when putting water in the boiler while the locomotive is standing still or drifting. Under these two circumstances, a pump should never be used unless it is equipped with a live-steam feed-water heating arrangement, or unless the boiler has a top boiler check equipped with a spray valve so as to avoid slugs or layers of cold water circulating back to the firebox. Another form of thermal shock may be avoided by stressing the

importance of firing up and blowing down boilers slowly.

A second cause of water-side cracking is stress corrosion, where localized areas of high strain are attacked by boiler water, or by entrained gases, such as oxygen or carbon-dioxide. The use of proper inhibitors seems to be the remedy for this condition. Corrosion also may

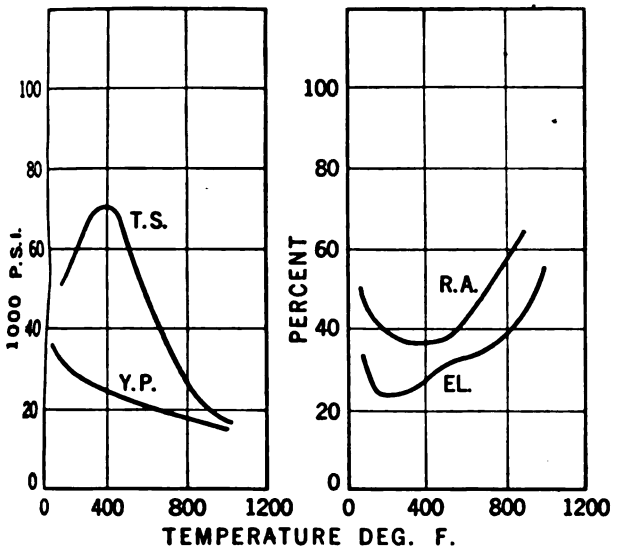


Fig. 6—Effect of temperature on the physical properties of double-refined wrought iron

occur from the use of dissimilar metals in fire-box construction.

Corrugated Sheets

Corrugation of sheets is another major cause for removal, and also the cause of many staybolt leaks. In some instances, pronounced corrugations on new sheets have forced their removal after an extremely brief service life, in order to avoid the danger of mud and scale accumulating in the depressions, and thus causing overheating. Corrugating is always an evidence of insufficient strength at the operating temperatures encountered. These operating temperatures are greatly influenced by design. Localized hot spots resulting from a circulation lag may be cited as an extreme case. Scale formation, mud deposits, or an oil film, also are frequent causes of an increase in operating temperatures, and in some instances intense heat may be localized in an area due to the location of the burners in an oil-fired locomotive or the drafting in a coal-fired engine. Low water may be included as an occasional cause of over-heating. An example of the effect of design in overheating is found in a study of the early failure of side sheets on a new Mallet-type locomotive after seven months' service. The affected area was confined to 30 sq. in. under the arch. Reported metallographic examinations showed that the steel had been heated to 1,600 deg. F. on the fire-side surface, and since no scale or oil films were present, such overheating must have occurred from a circulation lag.

The velocity of the circulation of water is of equal importance to the velocity of the gases on the heating surface. If the scrubbing action of the water circulation is insufficient to remove the steam bubbles from the heating surface as they form, the layer of steam will act as an insulating blanket that reduces the rate at which heat is absorbed from the firebox sheet.

Other investigations in the study of firebox steel failures have shown similar evidence of hot spots the locations of which depended on design.

All of the above causes of overheating drastically reduce the physical properties of plain carbon steel and the remedy can lie not only in correcting the underlying causes but in selecting a steel which has a higher factor of safety at elevated operating temperatures and which thus resists corrugation. Some railroads have endeavored to overcome corrugating by using a thicker firebox sheet. Almost invariably the slower heat transfer through these heavier sections has raised the temperature of the fire-side of the sheets to a point where fire-cracking occurred. The answer, therefore, is the use of the thinnest sheet which design considerations will permit, and the selection of an alloy steel the strength of which at temperature accomplishes the resistance to corrugation only otherwise obtainable by the use of a thicker plain carbon sheet.

Exception has been taken by Mr. Rennie to the above conclusions, on the ground that corrugations resulting from poor operating or maintenance conditions, "defy the curative power of any metallurgical technique." The writer, however, must disagree, in view of actual service records. As an illustration of the value of high strength at temperature, an extreme case reported by Ray McBrian, engineer standards and research, D. & R. G. W., might be cited of a crown sheet that failed at 1,350 deg. F. resulting in a boiler explosion. At 1,385 deg. F. the crown-sheet material (A. A. R. carbon firebox steel) had a tensile strength of about one-ninth of its room temperature strength, or 5,600 lb. per sq. in. Carbon-molybdenum firebox steel at this same temperature has a tensile strength of some 13,400 lb. per sq. in. Unfortunately 5,600 lb. per sq. in. tensile was 2,400 lb. per sq. in. lower than the working stress at that temperature, and the boiler pressure alone was sufficient to cause a failure. Mr.

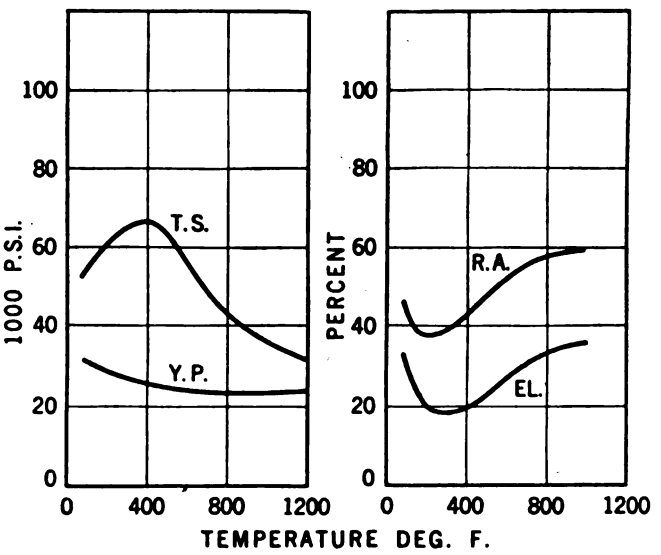


Fig. 7—Effect of temperature on the physical properties of molybdenum wrought iron

McBrian concludes that, had carbon-molybdenum steel been used, it could not have failed at this working stress. This is confirmed by data on elevated temperature physical properties and by the A. S. M. E. Boiler Code Committee's published work on Allowable Working Stresses for various alloy steels at elevated temperatures.

The determination of the temperature gradient in a firebox is one in which many variables affect the calculations, such as the location in the firebox, and the method of measuring coatings of scale and oil. Severe coatings of scale or oil can raise the temperature on the fire-side to 1,250 deg. F. or higher. Cases are reported where circulation lag has raised the temperature to 1,600 deg. F., and there are indications that "flash temperatures" may

approach 1,400 deg. F. Past practice has been to specify materials based on room-temperature physical properties and to ignore completely the fact that the materials are not to be used at this temperature. Figs. 4 and 5 offer a comparison of the elevated-temperature physical properties of standard firebox steel and carbon-molybdenum steel, from which the actual physical properties at operating temperatures may be estimated.

Even an alloy steel will not resist corrugation if there are too few staybolts on irregular or too widely spaced centers for the particular operating characteristics of the type of locomotive involved. These characteristics vary widely and they accentuate the need of a study of photoelasticity on this subject.

Staybolt Failures

Breakage of bolts usually occurs through corrosion fatigue, starting either from fatigue cracks in the root of the threads, or from cracks resulting from the mechanical working of the bolts between the wrapper and firebox sheets. In steel staybolts, this is accentuated by the operating temperature, which lies in the blue-brittle range, and by the susceptibility of steel to aging and subsequent sudden breakage. The bending stress at the wrapper sheet can theoretically be eliminated by the use of flexible staybolts, but this solution still leaves some bending stress at the firebox sheet and does not affect cracks starting at the root of the threads.

The indicated answer seems to lie in an alloy wrought iron, for wrought iron is far less susceptible to aging than steel and is highly resistant to corrosion fatigue. I know of no case where the transverse corrosion fatigue cracks usually found in the body of steel bolts have ever been found in a wrought-iron bolt, either with or without alloy. When, through the addition of an alloying element, wrought-iron is given the compressive yield strength of plain carbon steel at the operating temperatures encountered, then the only valid argument against wrought iron disappears, for it is the strength at the operating temperature and not the strength at room temperature that determines the usefulness of the material. Figs. 6 and 7 give a comparison of the physical properties of double-refined staybolt iron, with and without molybdenum. It is interesting to note that at 1,000 degs. F. molybdenum wrought iron has a tensile strength actually greater than that of some of the steel staybolts containing other alloying elements which have commonly been used. The above also affects the cases where unalloyed wrought-iron staybolts have pulled their heads.

A large percentage of staybolt leaks is due to poor practice in threading, fit, size and spacing. In addition to the above causes for leaks, corrugation of the firebox sheets is one of the principal offenders. Corrugation opens the metal-to-metal seal between the threads of the bolt and bolt hole.

A second cause of leaks is the tendency of the staybolt and of the adjacent material to yield on heating. The remedy for this is the selection of materials with increased compressive yield strengths at operating temperatures. It is interesting to note from the accompanying cuts that the compressive yield strength of plain carbon steel is no greater than that of molybdenum wrought iron at the temperatures involved on the fire-side, where the seal originally exists. In addition, wrought iron has some advantage over steel staybolts in that it upsets more readily in being driven, and hence seals throughout a greater distance. Leaks are also occasionally caused by a change in the type of water used. Where a boiler has operated for some time on alkaline water, a seal has been created by a product of evaporation. This seal will be dissolved upon changing to an acid water, or vice versa.

The advantages of seal welding are that it prevents leakage and gives the careful support to the sheet of a tight, well-fitted, standard type installation. Its disadvantages are cost, possible sudden failure through undetected injury to the sheet material, and possible weld cracks arising from thermal gradient stresses. When conditions permit further development of the explosive-charge method of expanding staybolts in position, the low cost and time saving of this alternate method of giving stays a perfect fit, will undoubtedly have much to recommend it.

On one road, over the past three years, the mechanical inspector advises that by the use of molybdenum wrought iron, he has reduced breakage of crown bolts and flexible staybolts by 80 per cent. No corrosion of bolts or burning of heads was found. Similarly, on an entire class of new power purchased in 1941 and equipped with carbon-molybdenum steel fireboxes and molybdenum wrought-iron bolts, there is a record of no leaks, no cracks and no broken bolts in a service where these troubles were previously severe.

Fitting and Seal Welding of Staybolts

By F. P. Huston

The International Nickel Company, Inc.

A wide range exists among various railroads in standards applied to staybolt thread tolerances, tap tolerances and requirements for fits. The A.A.R., after much study, has proposed the adoption of the Class 3, medium fit, established by the National Screw Thread Commission as the standard to apply to staybolt fits.

What does the Class 3 fit mean when applied to staybolts and how can it be obtained? It means, according to the definition: *threaded parts which are to assemble nearly or entirely with the fingers and must have the minimum amount of shake or play between the threaded members.*

Since it is generally felt that a wrench-tight fit is necessary when screwing the staybolt through the two sheets, acceptance of this definition will require a change in the thinking of those who insist on a fit so tight that considerable force must be applied to the wrench.

Steps to be taken to obtain the Class 3 fit likewise call for changes if the standardization we desire is realized. The first change suggested is the adoption of the specified tolerance limits for screw threads as fixed in the standards for the Class 3 fit. These tolerance limits are: basic pitch diameter plus .000 in. minus .004 in. The next change is the use of taps sized to produce tapped holes which give the desired fit.

The following range of thread tolerances is suggested: From plus .000 in. to minus .002 in. of the basic pitch diameter for staybolts, and plus .001 in. to minus .001 in. of the basic pitch diameter for the matching tap, to under minus .002 in. to minus .004 in. of the basic pitch diameter for staybolts, and under minus .001 in. to minus .003 in. of the basic pitch diameter for the matching tap. Matching taps may be varied according to preference provided the limits set for the Class 3 fit are not exceeded.

Color symbols might well serve to enable the boilermaker to select at once the right tap. Go-no-go gages should be used to sort the staybolts into the two lots which might well be marked green for basic to minus .002 in. and red for under minus .002 in. to minus .004 in. Matching taps are marked in a like manner.

Lead and other errors affect staybolt fits. Staybolts must be threaded on modern threading machines equipped with lead screws if they are to meet lead and other

error requirements. Ordinarily no difficulty is encountered with taps because of these errors except when the over-all thread length on the tap is insufficient to insure continuity of lead in the tapped holes through the two sheets. This latter difficulty, however, is encountered frequently and is important.

To insure continuity of lead through the two sheets with standard reamer staybolt taps, the tapered portion of the threads must enter the second sheet to a sufficient length to maintain the thread cut before the last full thread leaves the first sheet. The minimum over-all length of the threads on the tap must exceed the water space by at least ½ in. and 1 in. is better.

Tapping practice should conform to the following requirements:

1—Taps shall be maintained reasonably sharp.

2—The tapping speed shall not exceed that recognized as good machine-shop practice for the size used.

3—The tap shall be driven in a manner to avoid whip and excessive bending.

4—The threads in the tapped holes shall be sharp and clean. After the full thread is cut the straight portion of the threads on the tap shall be finger free without excessive shake.

The staybolt should be run in right after the tap.

There are approximately twenty locomotives now in service on five roads in this country and in Canada with seal-welded staybolts in the side sheets. Their boilers are fitted with various combinations of staybolts and side sheets, including:

1—⅞ in. dia. straight rigid Monel staybolts in nickel-clad side sheets.
2—1 in. dia. straight rigid iron in nickel-clad.
3—1 1/16 in. dia. straight rigid iron in nickel-clad.
4—⅞ in. by 1 1/16 in. reduced body Monel in nickel-clad.
5—Same as 4 except in steel.
6—⅞ in. dia. straight rigid Monel in steel.
7—1 in. dia. straight rigid iron in steel.
8—1 1/16 in. dia. straight rigid steel in steel.

The oldest application has, to this writing (July, 1944), covered more than twice the average mileage and life obtained under the conventional riveted-over method for their particular service and class. Several others have well exceeded the mileage when patching and staybolt renewals would become necessary with conventional construction. All without exception are free from leakage, corrugations, barnacles and other evidences of foreseeable failure. They appear the same today as when they were put into service.

A striking comparison between seal welding and conventional construction appears in two locomotives of the same class operating under identical service conditions which demonstrates the advantage of seal welding. The advantages of seal welding are shown in the table.

A Comparison of Seal Welding and Riveting the Inside Ends of Staybolts

	Locomotive A	Locomotive B
In service	April, 1943	Jan. 1944
Materials	⅞ in. diameter Monel staybolts in nickel-clad—one side. 1 in. diameter iron staybolts in carbon steel on other side.	Same
Construction	Staybolt screwed through. Ends seal welded on fire side —both sides.	Same except ends riveted-over
Enginehouse maintenance	None	Numerous dumps for calking leaky staybolts. 150 iron staybolts renewed
Condition as of July, 1944	No apparent change	Both side sheets renewed

In order to determine the value of seal welding as insurance against leaky staybolts and cracked side sheets it was necessary to obtain permission from the Bureau of Locomotive Boiler Inspection of the Interstate Commerce Commission to seal-weld the various applications now in service. This permission was freely granted.

Diesel Mechanical Repairs

(*Continued from page 56*)

complete reconditioned units; fuel, water and steam lines should be cleaned and all valves should be inspected and repaired; outer casing, ducts, stack and smoke jack should be inspected and necessary repairs made.

The locomotive water tank should be drained, flushed and thoroughly cleaned and the heating coil and its connections inspected. Lagging or insulation should be repaired as required.

Locomotive water lines, steam lines, air and fuel lines should all be gone over, blown out if necessary to remove accumulated scale and dirt, and all connections, valves, clamps, supports, insulation, etc., should be inspected and repaired. Fuel and water tank filling connections should likewise receive attention.

Trucks should be removed and completely dismantled. Truck frames, brake rigging, springs, equalizers, etc., should be inspected and thoroughly cleaned; equalizers should be tested with the magnetic tester. Pins and bushings should be renewed as necessary and wear plates should be built up or replaced. Journal boxes should be dismantled and cleaned and roller bearings should be checked and cleaned or renewed. Wheels and axles should be inspected and wheels turned or renewed; if the latter, the axles should be magnaflux tested after the wheels are removed. Motor mounting and axle bearings and caps should be given necessary repairs and axle gear should be inspected. Brake cylinders should be cleaned and lubricated in accordance with standard practice and slack adjusters given necessary attention.

The complete air brake equipment of the locomotive should be given the customary system of attention in accordance with the regular practice of the individual railroads.

In like manner other more or less standard mechanical parts of the locomotive such as the cab and its appurtenances, including safety appliances, warning devices, windows, window wipers, seats, arm rests, doors, etc., pilot draft gears, couplers, should all receive necessary attention and repairs. In this connection, it is good practice before release of the locomotive to clean and paint the entire interior (including the Diesel engine generator set or sets) which gets grimy and dirty rather rapidly and does not lend itself readily to cleaning while in service. Opportunity should also be taken to clean thoroughly the under parts of the locomotive of oil and dirt and to clean and paint the battery compartment or compartments with acid-resisting paint. Exterior painting, of course, will be handled in accordance with the regular painting schedule based on service conditions.

When the foregoing maintenance attention and repairs are completed (also the electrical work, which will be described subsequently) it will usually be found to be good practice either to take the locomotive on a test run on the railroad or to utilize its delivery run from the shop, if removed far enough from the terminal, to make a final check of its operating adjustments and conditions before it enters revenue service. While a great deal of this can, of course, be done on the stationary loading tests at the shop, such items as running gear performance, braking, bearing heating, etc., can best be checked on an actual run and this will go far to insure satisfactory operation when regular service is started. An alternative to this is the use of the newly released locomotive in local service for a time before undertaking its regular assignments.

EDITORIALS

Radio for Train Communication

On the basis of extended investigations and hearings held in Washington, D. C., the Federal Communications Commission has issued proposed allocations of radio channels to the various classes of non-governmental services in the radio spectrum from 10 kilocycles to 30,000,000 kilocycles (30,000 megacycles). The Commission proposes that the railroads, jointly with other services, use a few channels below 3 megacycles (mostly for ship-to-shore service); that they have 33 clear channels in the 156 to 162 megacycle range for end-to-end communication and that they use television channels 44-50, 54-78 and 192-216 megacycles for yard and terminal service. These allocations will give the railroads considerable latitude to use radio or carrier systems, or a combination of the two, according to their requirements. Considerable activity in this field can be expected and the Commission urges that applications be made as soon as practicable so that further knowledge of the suitability of the allocations may be determined.

No allotments were made in the 2,600-2,700 range requested by the railroads since there is little knowledge of the performance of radio in these frequencies and apparatus for extended applications will not be available until after the war. This is a completely logical position for the Commission to take, but it is to be hoped that the railroads' former position may be avoided.

Since the early twenties, the railroads have experimented with radio for train communication, but it was never used in regular service, first, because the apparatus available was not completely adequate, and second, because the railroads were obliged to work with temporary experimental wave bands and had no assurance that they could use them permanently.

Now the situation is markedly changed, but some kind of an understanding would do much to assure some highly desirable development work. Research work done by the Rock Island indicates that frequencies in the neighborhood of 3,000 megacycles may be better for train communication than those which have been proposed by the Commission. Of course the Commission has acted properly in not proposing their assignment since, for the present at least, knowledge of performance as well as equipment available is inadequate. The difficulty is that with no assurance that channels in the higher frequencies will ever be assigned for train communication, the railroads are again in a position similar to that in which they were before. They can scarcely afford to spend time and money to study a science the application of which may be denied by government order.

Fortunately, the Commission is completely cooperative. It is evidently appreciative of the technical aspects of radio developments and intends to see that these developments are given every opportunity to be used in the public interest. Fortunately too, as technique is improved to cover the higher frequency bands, an enormous number of new channels are made available. It is to be hoped that some arrangement or understanding may be reached which will not only permit but will encourage the railroads to continue experiments with the higher frequencies.

Speed-Up On Tank Cars

Recently it was announced in Washington that there was an immediate need for at least 15,000 more tank cars for petroleum service than there are available in the country. It was also announced that they could not be built and that a desired increase in petroleum movements would have to be obtained through higher speeds of train operation and quicker turnarounds at terminal points. To the lay reader the solution probably appeared reasonable. But, the lay reader has not seen the existing cars through the eyes of a car-repair-track foreman; he does not know that costs of repairs are even now almost totally disregarded in the interest of quick release of cars at repair points; he does not realize that many railroad operating men consider the present speeds too high for such equipment. He cannot know how much increasing the effective load-carrying ability of the approximately 110,000 tank cars in petroleum service by an additional 14 per cent requires of the mechanical forces now engaged in their upkeep.

We are now well into the third year of heavy movements of petroleum products by rail and only the utmost in cooperation between car owners, the railroads, shippers and consignees has made possible the almost incredible delivery rates which were achieved during 1943 and 1944. There has been time to build new cars but we cannot criticize because they were not built. Other things came first. We can wonder, though, at the newspaper publicity, often government inspired, about

the repairs made to breaks in the "Big Inch" or other pipe lines. Evidently it has never been thought necessary to repair the "leak" in the railroad pipe line resulting from excessive wear and tear on tank cars many of which were almost ready for the scrap pile when circumstances required that they be placed in service.

Knowing railroad carmen one knows that they will do their best to find still further ways to reduce car-repair time on tank-car equipment and to turn the cars over to the operating department in the safest possible condition for high-speed service. Whether their contribution will be enough to help meet the car-deficiency situation is questionable. Certainly, no one envies them their job.

Shop Modernization Programs Are Needed

During 1944 there was more activity on the part of the railroads in the machine-tool and shop-equipment field than has been evident for many years in the past. There are several reasons for this. First and foremost is the fact that the railroads have been out of the shop equipment market for many years and have been wearing out machine tools and shop equipment at an accelerated rate. The combination of wear and obsolete equipment has probably been as much responsible for the sudden buying spurt as any other factors.

Other important considerations influence the roads to invest part of their earnings in new facilities. Acquisition over a period of some 10 years of a substantial number of large modern steam locomotives, most of which are equipped, in part at least, with roller bearings has had a decided influence on the ability of the heavy repair shops to overhaul power with the degree of accuracy required in modern locomotives. The large number of Diesel-electric locomotives, of both road and switching types, that have gone into service in the last five years has made it absolutely necessary to build and equip many new facilities for both light and heavy repair work on this type of power. The stepping up of shop operations involving the internal combustion locomotive and its electrical equipment has brought into the sphere of shop equipment many items heretofore more or less unfamiliar to the railroad field.

Certain factors related directly to operation have also had their influence. High speed, coupled with heavy loads and the necessity for stopping heavy trains moving at high speeds, has been instrumental in creating a wheel problem on practically every railroad. The character of work which it is necessary to do in the average wheel shop today, whether it be for cars or locomotives, is such that it demands a type of shop equipment far superior to that with which the railroads have been getting along for many years. Roller-bearing axles on both locomotives and cars have had their influence on the type of wheel-shop equipment which is needed. It is not surprising that foremost among the demands on the part of practically all roads is that group of machine tools, plus handling facilities, which go to make up a modern wheel shop.

Every shop needs to, and wants to, increase output, and particularly during the past two years when the skilled shop forces have been rapidly depleted as a result of the demands for men in the armed services, this question of output has assumed serious proportions. Unlike many other industries which, because of the peculiar nature of their operations, have kept their plants constantly equipped with up-to-date machinery the railroad shop has been unable to take advantage of many of the new developments in cutting tools and tooling equipment simply because the physical condition and power characteristics of obsolete machine tools made the adoption of these new developments impractical.

As unusual as may be the present activity in shop equipment buying by contrast with the 10 years preceding the war, most of the railroads find themselves in a difficult position with respect to their ability to improve shop output and reduce the costs of maintenance. In spite of an excellent cash position their lack of definite improvement policies in the matter of shop and engine-terminal facilities over a period of years has been responsible for a vast accumulation of obsolete equipment, housed in many cases in shop structures that were built years ago when a far greater number of locomotive units had to be put through the shop at more frequent intervals. The result of all this, which we are witnessing today, is that we have many shops poorly suited to present-day needs, in which the high cost of handling heavy parts is occasioned by the inability to arrange and re-equip departments in such manner as to take the greatest advantage of modern cost-saving facilities. If some accident of fate should make it necessary for many railroads to cut their shop floor space in half and do the necessary things to modernize the remainder the chances are that the cost of doing work would be materially reduced.

This condition is responsible, in many cases, for indecision in the matter of shop improvement programs. Most railroads do not have any such programs, except in name. That which is needed most today is a thorough engineering study of the problem of equipment maintenance. The character of this problem has changed drastically in the past five years but our thinking, in the matter of repair facilities, is still much along traditional lines.

It is not surprising that railroad managements at times have difficulty in trying to decide whether or not a million dollars will return most in value if invested in shop equipment, new locomotives, new cars, roadway improvements or in some other facility. Each department of a railroad, engrossed as it is and should be, in its own peculiar problems, can, as a rule, put up a pretty strong argument to the management for the

necessity and justification for its requests for appropriations. The departments most successful in maintaining the modern character of their facilities are probably those which have the most complete and factual data coupled with executive personnel who have that rare ability to sell management to the idea of spending money to make money.

If there can be attributed to railroad managements any defect in their present course it is in allowing things to take their course; by this process, on many roads, the cost of maintaining equipment is not being reduced at a time when there never was so much available in the way of modern facilities for accomplishing that very purpose.

Many railroad managements are prone to look outside their own organizations for assistance in the matter of improvement programs. The difficulty in this is that there is nowhere to go to get the help. It has to come from within and it is a problem that can be approached only from an engineering standpoint—not mechanical engineering alone, nor civil, electrical or production engineering alone but a combination of these several approaches to a problem that involves all of them. For, railroad operation today is a complex job in which it is quite possible to spend millions for a facility of one type and be denied the real value of that facility because of the failure to provide collateral facilities with which to keep it in service. The true facts of the equipment-maintenance case are that maintenance facilities *have not* kept pace with the equipment itself and management must recognize this.

Treating Boiler Feedwater

As pointed out by W. A. Pownall, assistant to the superintendent of motive power, Wabash, in a prepared discussion of feedwater treatment at the recent annual meeting of the A. S. M. E. Railroad Division in New York, most railroads now use some form of water treatment to reduce or prevent scale formation in locomotive boilers. They have competent water engineers for supervising the treatment, and manufacturers of boiler compounds have well-organized forces of traveling representatives who understand the principles of water treatment and who instruct and supervise the carrying out of treatment on individual railroads.

One fact, perhaps not always appreciated, is that the decrease in locomotive failures due to leaking flues was largely effected by the electric welding of flues to the back flue sheet and this reduced the urgency and doubtless to some extent delayed effective boiler water treatment. Years ago, roads operating under hard-water conditions had a great number of road delays caused by leaking flues and they were forced to adopt some form of water treatment to reduce scale formation which frequently caused locomotive failures on the road. On the Wabash, for example, in the pre-treatment days, there were nearly 1,000 locomotive leaking flue failures in a year, which may be compared with one failure a year, at present.

This notable improvement has not been due to welding, as small flues, or tubes, are not welded to the flue sheet on this road. It must be credited largely to effective water-treatment which was begun in 1912 and consisted essentially of the soda ash treatment, alone, except at one point when high hardness and high iron content justified a lime-soda plant.

The following specific improvements are listed by Mr. Pownall, as possible with effective modern boiler water treatment. Practical elimination of locomotive failures caused by leaking flues, staybolts or fireboxes; increase in time between flue resetting from 6 to 12 months, to 4 to 5 years; 95 per cent reduction in broken staybolts; firebox renewals reduced from 12 to 0.4 per 100 locomotives per year; firebox sheets or part sheet replacements reduced 90 per cent; period between boiler washout increased from 10 to 30 days; fuel consumption reduced 10 to 20 per cent.

It is obvious that successful treatment of boiler feedwater requires continuous addition of the prescribed chemical dosages to all waters, and promptness is of prime importance in translating road checks of water condition into corrective action so as to avoid, as far as possible, even temporary over or under treatment. The blowing down of locomotive boilers is essential in order to relieve foaming conditions and one point, made in the discussion, is that the main blow-off cock should be located in the back corner with a perforated pipe connected to it and lying on the back mud ring.

Undoubtedly, greater emphasis should be placed on securing in every case the best possible source of water supply. As pointed out by Mr. Pownall, any plan of water treatment should include a careful survey of existing supplies, with a view to replacing bad water with waters of better quality providing the expense of the change is not prohibitive. Well waters that carry a moderate amount of sodium carbonate are already treated and need no control. In one instance on the Wabash, for example, a well water high in sulphate hardness required many tons of soda ash annually to render it non-scaling. After a careful survey, another strata was located within a mile of the old location; the new water had about one-third the total hardness and contained two grains of sodium carbonate per gallon; no treatment whatever was required with the new supply.

Without this sort of intelligent effort in securing the best waters available, treating them where necessary and developing satisfactory equipment and technique in blowing down locomotives on the road, it would have been absolutely impossible for the railroads generally to make the records of locomotive performance, attained in recent years and culminating in 1944.

IN THE BACK SHOP AND ENGINEHOUSE

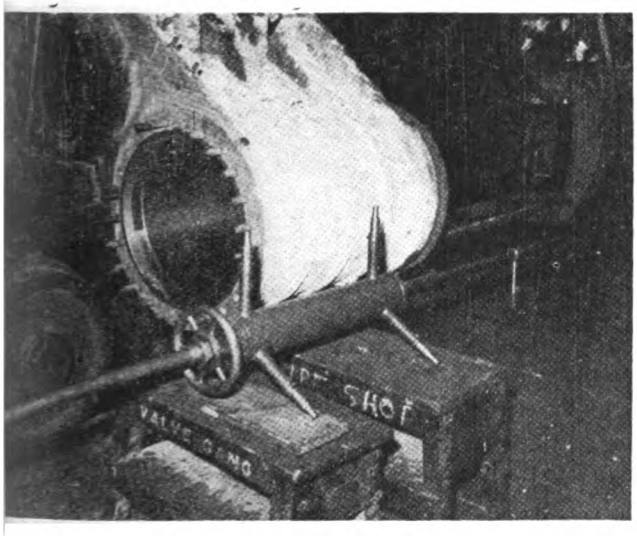
South Tacoma Shop Devices

The centering device for locomotive cylinders illustrated has six self-centering guides, screw operated. When placed inside the cylinder with the guides in contact with the cylinder wall, the long rod is in the exact center of the cylinder. The pointer on the long rod serves as a guide for measuring and locating top and bottom crosshead guides and for aligning them in proper relation to the cylinder.

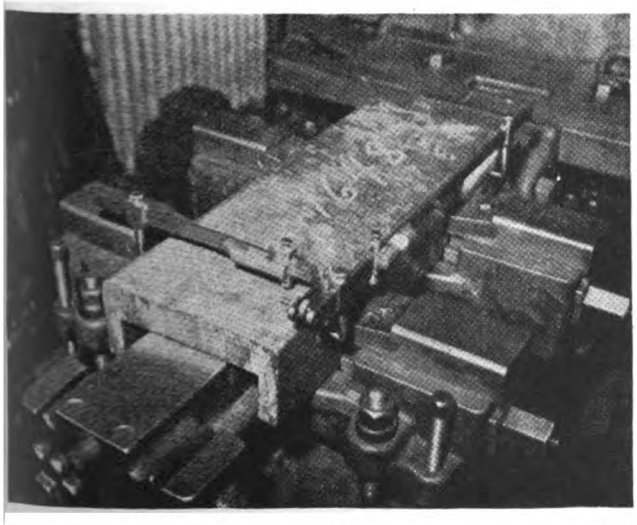
A convenient arrangement of levels for setting up locomotive shoes and wedges in a shaper for machining is shown in another illustration. This device is attached to the shoe or wedge at three points, using the center punch marks made in laying out. The table is then adjusted at the end and sides until both glasses show level. This device is made right and left.

A third illustration shows a convenient device for closing locomotive pedestal caps. It consists of a truck-mounted, heavy steel slab equipped with a substantial crossbar and 2½-in. vertical adjusting screw which is used to hold the pedestal cap in position for heating and upsetting. The cap is heated with an acetylene torch at a localized point and pressure applied by driving in the wedge with a sledge. This makes close adjustment possible at the exact location desired, and saves considerable time as compared with heating the entire pedestal cap.

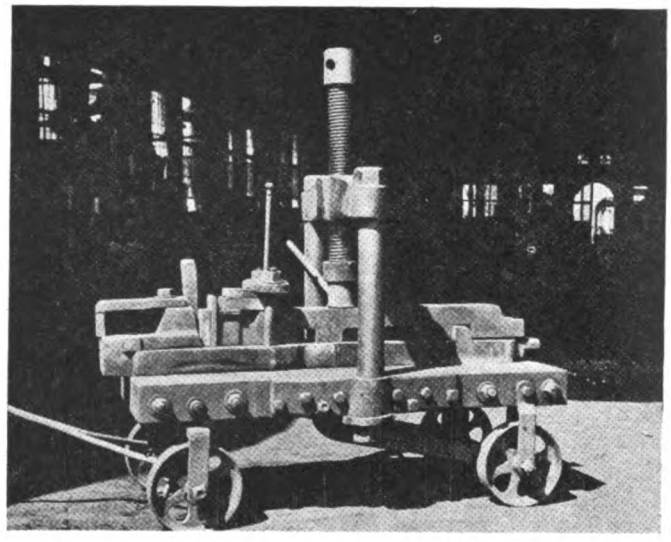
These devices are in use in the South Tacoma, Wash., shops of the Northern Pacific.



Centering device for locomotive cylinders



Levels used for setting up locomotive shoes and wedges for machining

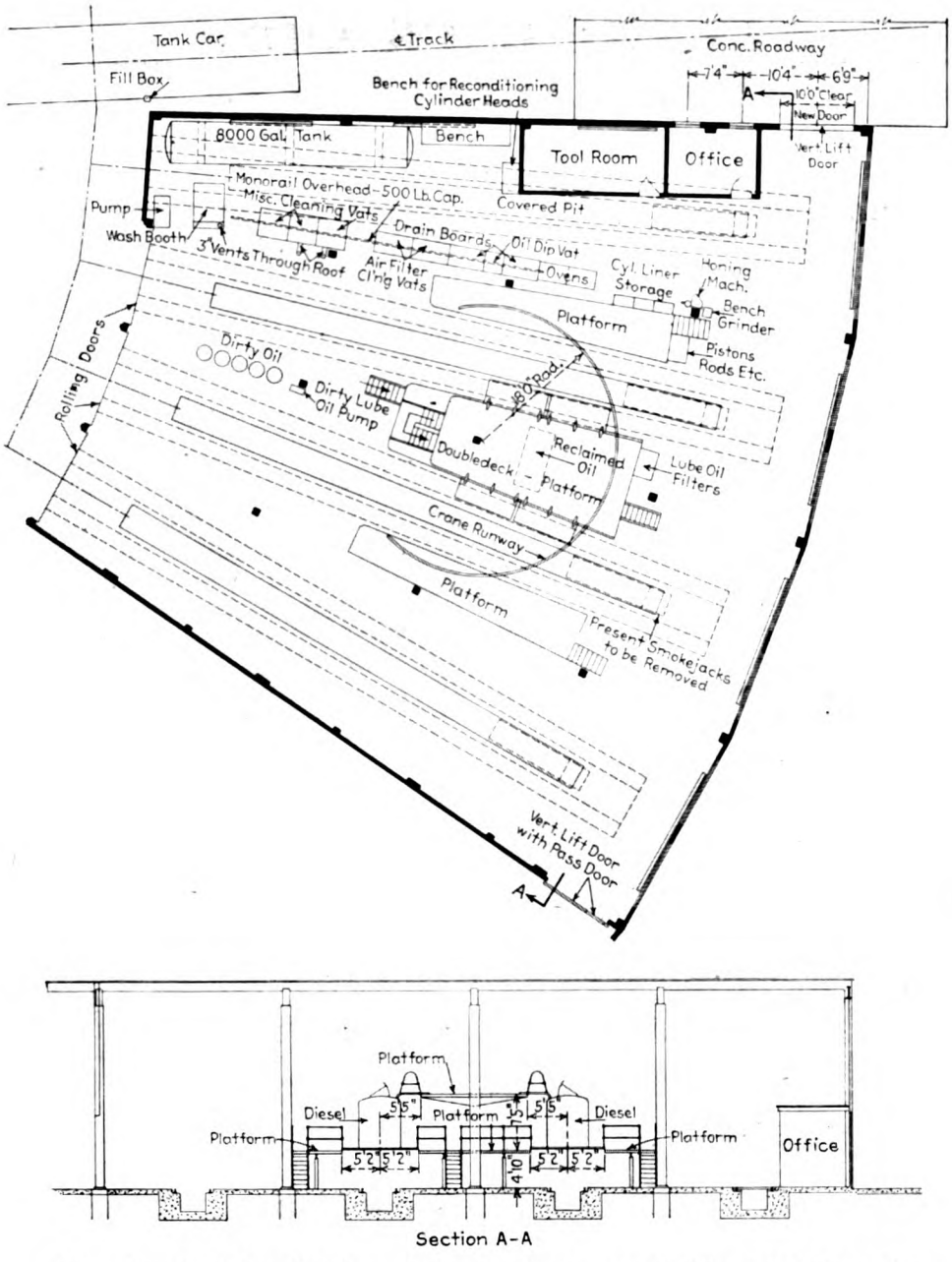


Device for closing locomotive pedestal caps

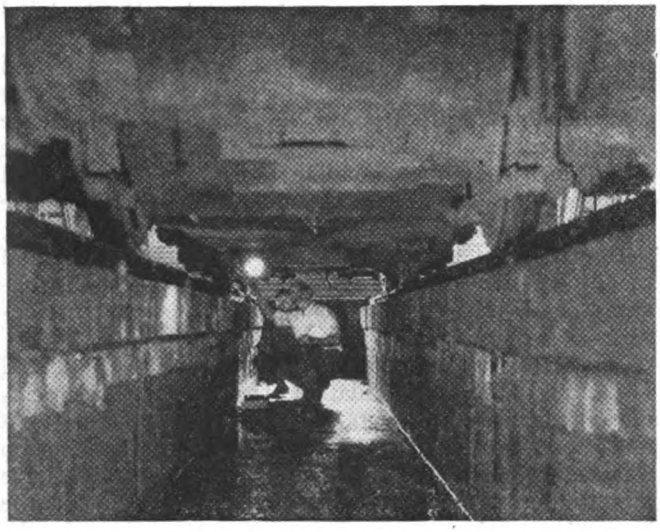
Diesels at The Enginehouse

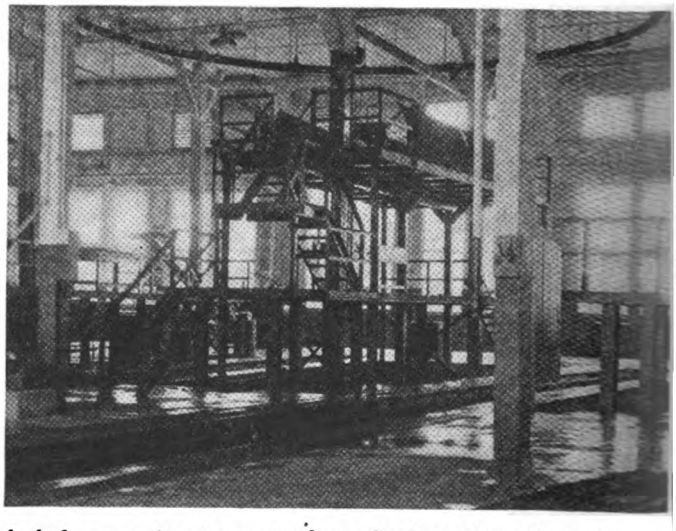
At the present time the Baltimore & Ohio has 15 Baldwin-Westinghouse 1,000-hp. Diesel-electric switching locomotives operating in its Philadelphia, Pa., terminal area. The question arose before these locomotives were placed in service as to what type of maintenance and repair facilities should be installed to care for them. It was decided that a portion of the East Side enginehouse could be adapted for this work at a minimum of expense and that it would be possible to install adequate and satisfactory facilities. Four stalls at one end of the enginehouse were walled off from the rest of the house; the doorway of the end stall was walled in solidly and the other three stalls were fitted with overhead roll-type doors. The rear and end walls consist almost entirely of windows.

The space made available by closing off the end stall was utilized for the installation of an 8,000-gal. lubricating oil tank, cleaning vats for filters and other parts, a tool room, storage space, a honing machine, other shop tools and an office. The remaining three stalls all have pits to permit necessary work being done under the locomotives. However, most of the work done in the shop is done on the two tracks nearest the tool room. A



Plan and sectional view of Baltimore & Ohio Diesel maintenance facilities at East Side engine-house, Philadelphia, Pa.

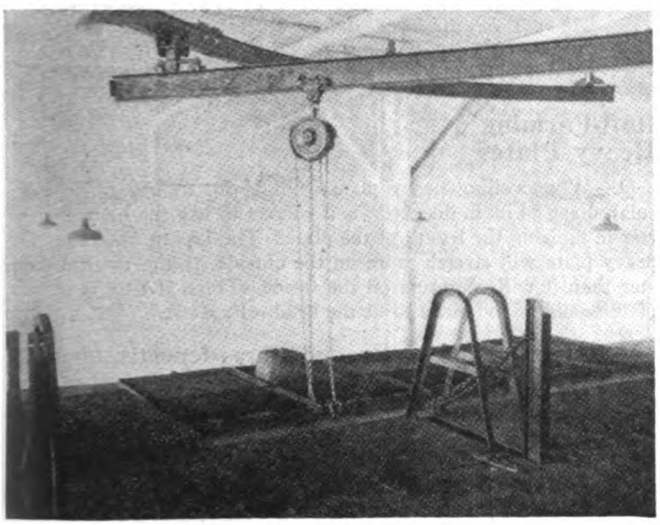




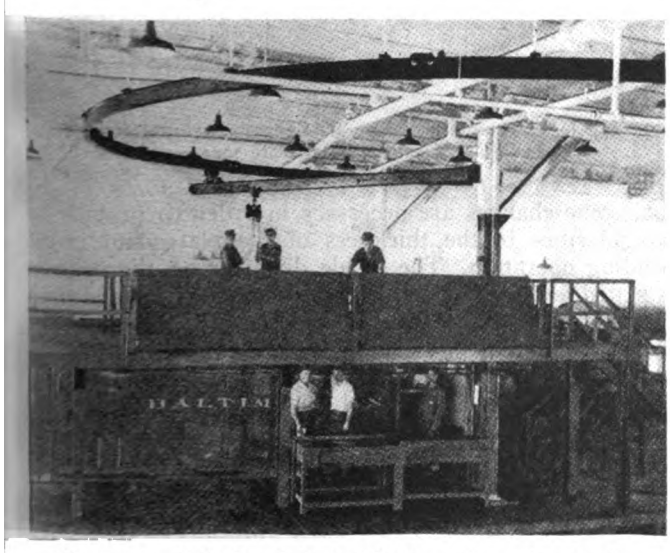
Left: The three stalls have inspection pits—Right: The two-level platform permits easy access for engine inspection and repair

two-level working platform was built between these tracks which gives access to all parts of the locomotives which may require inspection or repair. There are work benches for tools and parts on each of the platform levels. The upper level is served by a one-ton chain hoist mounted on a carriage which travels on a swinging boom. The boom is supported at its outer end on a curved track which has a 180-deg. swing. The use of this hoist permits the removal of heads, liners and other heavy parts which must be removed through the roof hatches on the Baldwin locomotives. Hinged steel-plate platform side extensions are lowered onto the top of the engine hood when the top platform is in use.

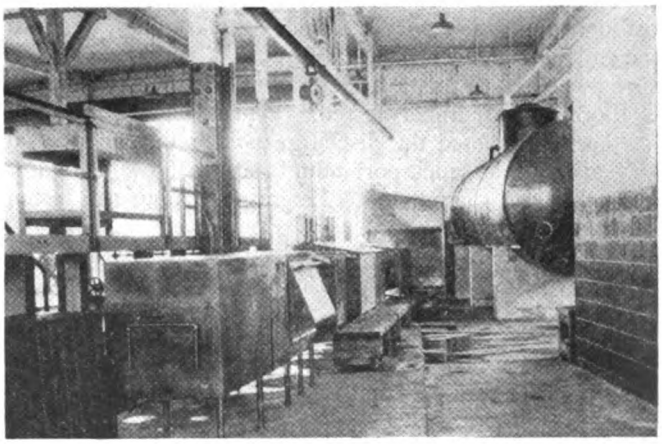
Apart from the use of the double-deck platform other features of the shop do not differ greatly from those ordinarily required in Diesel maintenance shops. Single-level platforms on the outside of the two tracks which are separated by the double-deck platform, give access to engine parts which can be reached through the side doors in the engine hood. The pits are not lighted. This feature was not considered necessary because of their relatively short length and the generally good lighting conditions in the shop through the windows and from the numerous overhead lights which have been installed. When extra light is needed in the pits, an ordinary drop light on an extension cord is used.



A chain hoist is used to handle heavy engine parts



The two-level platform is located between the working tracks



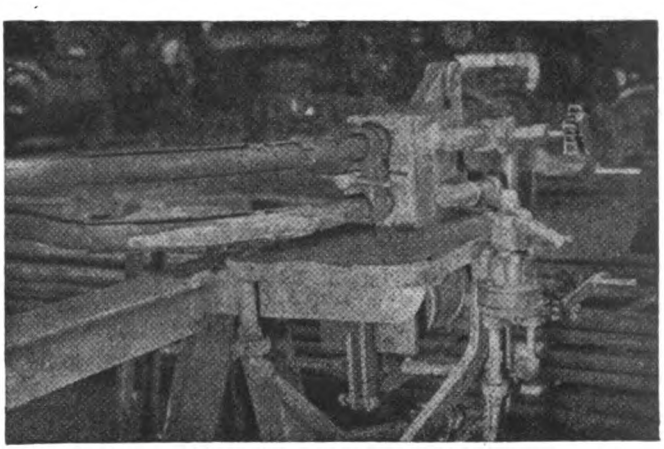
Filter cleaners and drying ovens are adjacent to the repair tracks

When wheels require removal it is necessary to use the regular drop-table facilities of the enginehouse. The railroad is prepared to make an installation exclusively for Diesel use if experience shows it to be necessary but, to date, the volume of such work has not resulted in delays to either steam or Diesel power.

Regular daily inspections of the switching locomotives are usually made during crew lunch hours in the territory where the locomotives are operating or at times when it is necessary for them to take fuel. Monthly inspections, of course, are made at the enginehouse. In general the inspection and maintenance procedures outlined in the Guide for Inspection and Care of Baldwin-Westinghouse Diesel-Electric Switching Locomotives are followed although the report forms used on the Baltimore & Ohio are set up somewhat differently than those which are available from the manufacturers.

Superheater Unit Tester

All superheater units removed from Southern locomotives at the Spencer, N. C., shop are tested hydrostatically at pressures which reach 1,000 lb. per sq. in. The unit being tested is first laid across two trestles and the ball-joint ends are fitted firmly against the head of the testing device. A slotted projection on the face of the test device passes through the superheater unit clamp and a steel wedge driven through the slot holds the unit tightly in position. Water is then admitted to the unit



Showing head of hydrostatic testing device for superheater units with a unit in place—Test pressures of 1,000 lb. per sq. in. are used

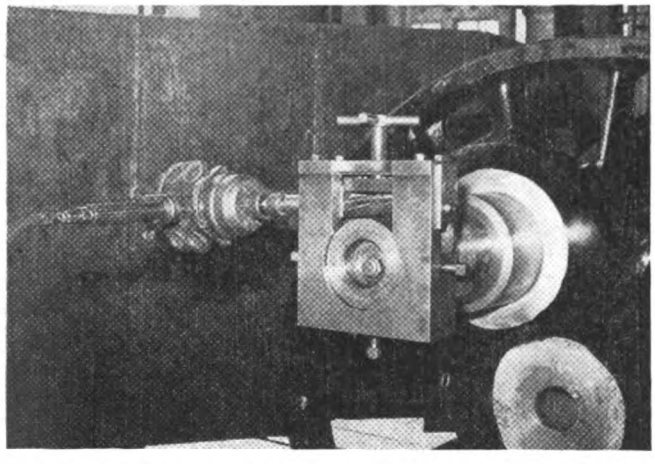
through one of the ports until an overflow indicates that the unit is full. The discharge port is closed and pressure increased to the desired amount after which the unit is thoroughly hammer tested. When the hammer test has been completed the discharge port is opened and an air valve at the inlet port admits air to blow all water from the unit. From 10 to 12 units per hour are tested in this way.

Crank-Pin Milling Machines

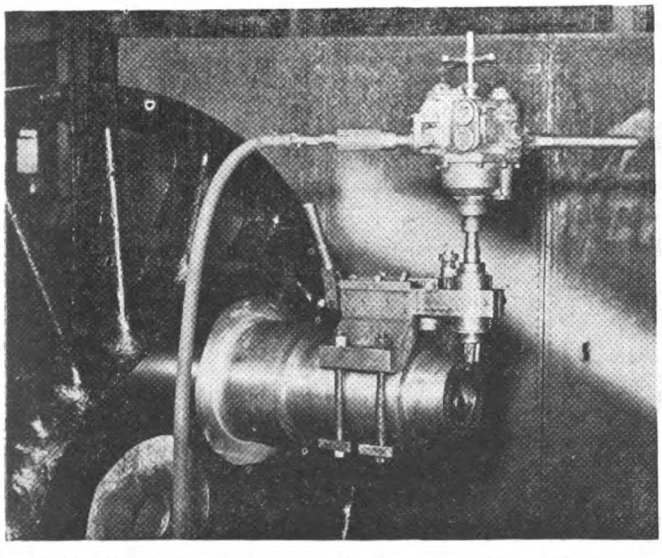
The illustrations show two devices which have been used with good results at the Northern Pacific shop, South Tacoma, Wash.

Referring to the first view, the machine illustrated is used for milling eccentric-crank keyways in the ends of locomotive crank pins. This machine consists of a V-block clamped to the crank pin and designed with a sliding bar support for the air-motor-driven end mill which performs the actual cutting operation. Cross-feed of the cutter-support bar is secured by means of the hand ratchet shown on the left of the machine which engages a screw used for feeding the milling tool into the crank pin.

A companion machine used for milling main locomotive crank pins for eccentric-crank-arm bolts is shown in the second view. This device consists of an inverted U-block which fits over the end of the crank pin and is held in place with set screws. The air-motor-operated milling cutter is supported in two steel bearings attached by a crossbar, this entire unit being capable of verticle motion in the U-block by means of the hand screw shown at the top of the machine. Operation of this hand screw, with the air-motor running, feeds the milling cutter quickly and easily into the crank pin to the desired depth.



Machine for milling main locomotive crank pins for eccentric-arm bolts



Machine for milling eccentric-crank keyways in locomotive main crank pins

Locomotive Boiler Questions and Answers

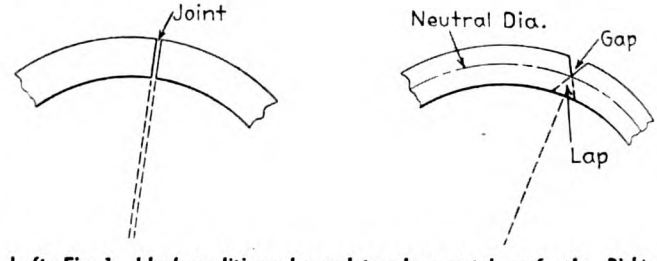
By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Roll-Forming Heavy Plates

Q.—When rolling heavy plate from ¾ in. to 1¼ in. to a circular shape 54 in. in diameter, is it correct to use the neutral diameter in figuring the length of the plate? The layout books say that heavy plate will stretch more on the outside of the neutral diameter than it will compress on the inside. Thus, if this is true the plate would be too large to fit the head.—F. E. R.

A.—The allowance for curvature depends upon the diameter of the curve and the thickness of the plate. The allowance can be calculated, but it often happens



Left: Fig. 1—Ideal condition where plate edges match perfectly—Right: Fig. 2—Result of cutting heavy plate square on ends

that some changes are necessary in order to provide for irregularities in the thickness of the plate and in the bending operation. The inside diameter of the cylinder is stated and the thickness of the plate is given and these figures are used as the basis of the calculations. The inside circumference is supposed to shorten and the outside is stretched in the rolling operation. The line midway between the inside and outside is supposed to be the same length after the plate is rolled as before, and therefore this is called the neutral axis.

If the calculation is made on the neutral diameter, then theoretical results would apply in practice. However, with thick plates, there is a great difference between the length of the inside circumference and the outside one

and a special allowance should be made in order that the two edges of the plate will roll together. The desired condition is shown in Fig. 1. The two edges match perfectly, and the joint would be finished with cover plates.

The condition where the edges meet at the neutral point but overlap at the inside circumference and fail to meet at the outside circumference is shown in Fig. 2. In this instance the ends of the plate were cut square, and there was not enough compression on the inside or enough stretch outside.

Fig. 3 shows the form of plate when cut according to the calculated length for the inside circumference, the neutral circumference and the outside circumference.

It will be seen that the distance between the lengths of the inside and outside circumferences is twice the thickness of the plate multiplied by 3.1416, or it is the thickness of the plate multiplied by 6.28. Instead of using this fractional value and making some allowance for the irregularity that may be due to the plate and the

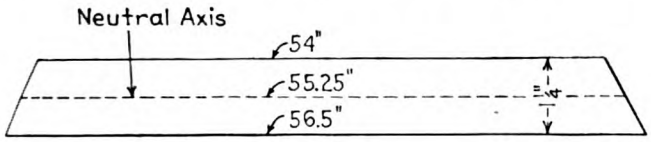


Fig. 3—Form of plate when cut to calculated dimensions for proper bending

rolling operation, some plate workers recommend the use of a factor of seven.

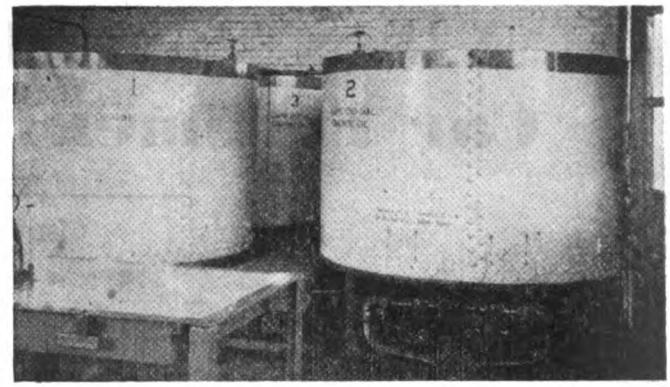
In the problem of the 54-in. cylinder made of 1¼-in. plate, the inside circumference is 54 × 3.1416, the neutral circumference is 55¼ × 3.1416 and the outside circumference is 56½ × 3.1416. It should be noted that the plate must be cut for the outside length. The difference between the inside and the outside lengths is 2½ × 3.1416 or twice the thickness × 3.1416 which equals the thickness × 6.28. It is recommended that a factor of seven be used in order to insure that the outside circumference will be long enough to satisfy all the needs.

Reclaiming Lubricating Oil

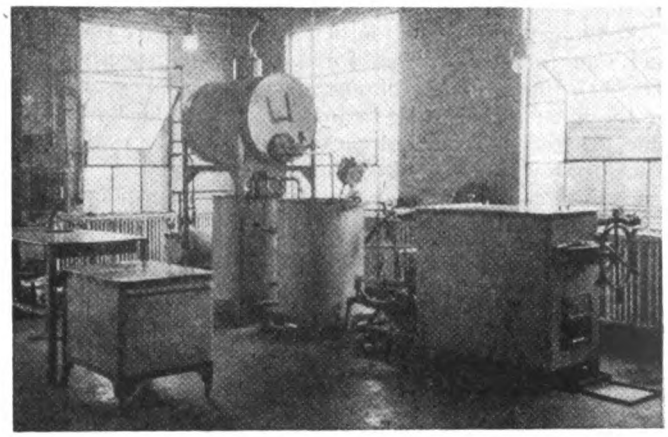
In the December, 1944, issue of the *Railway Mechanical Engineer* on page 549, certain of the Diesel-electric locomotive servicing and repair shops of the Southern railroad were described. The photographs here show the lubricating-oil reclamation facilities which are employed at Chattanooga, Tenn., in connection with the repair shop at that point. Operated by the stores department, they are actually an integral part of the repair and maintenance facilities of the mechanical department.

As used oil is removed from crankcases in the shop it is pumped through a pipe line to the dirty-oil storage tanks. The oil is drawn from these tanks and undergoes a re-refining process after which it is stored in tanks until the engineer of tests has checked samples and verified the fact that the oil meets all specifications for crankcase use. When approved the oil is pumped into the shop-servicing lines and used to fill completely drained crankcases or as makeup oil in others.

This system does away with any necessity for drum-handling of oil and meets the recommended practices for oil-reclamation facilities at Diesel-servicing points where the volume of work justifies such an installation.



Oil removed from crankcases in the Diesel shop is pumped to these dirty-oil tanks located in the oil house



An installation for re-refining used Diesel engine lubricating oil

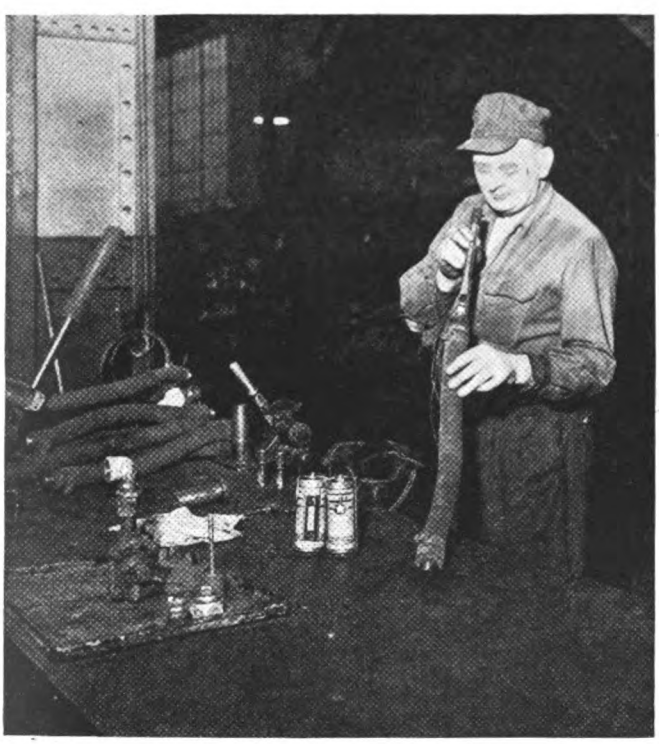
Tanks from which re-refined oil is pumped to the Diesel maintenance shop servicing line

With the Car Foremen and Inspectors

Air Hose Equipment

Air hose in railroad service is usually changed on a specific time basis, but on the Independent subways of the New York City Transit System the air hose is changed only when examination indicates that abrasion or other mechanical damage makes the hose unfit for service.

At the general inspection period air hoses are removed and sent to the air room for a physical inspection. It has been found that in almost all cases, failure is caused by the inner tube cutting or breaking at the hose nipples. The projection of the nipples inside the tube, makes a place for oil and condensation to be trapped. This results in decomposition of the rubber at that point, and



The inside of the hose near the ends is inspected by means of a small battery lamp and a 45-deg. mirror on the end of a tube somewhat smaller than the inside diameter of the hose

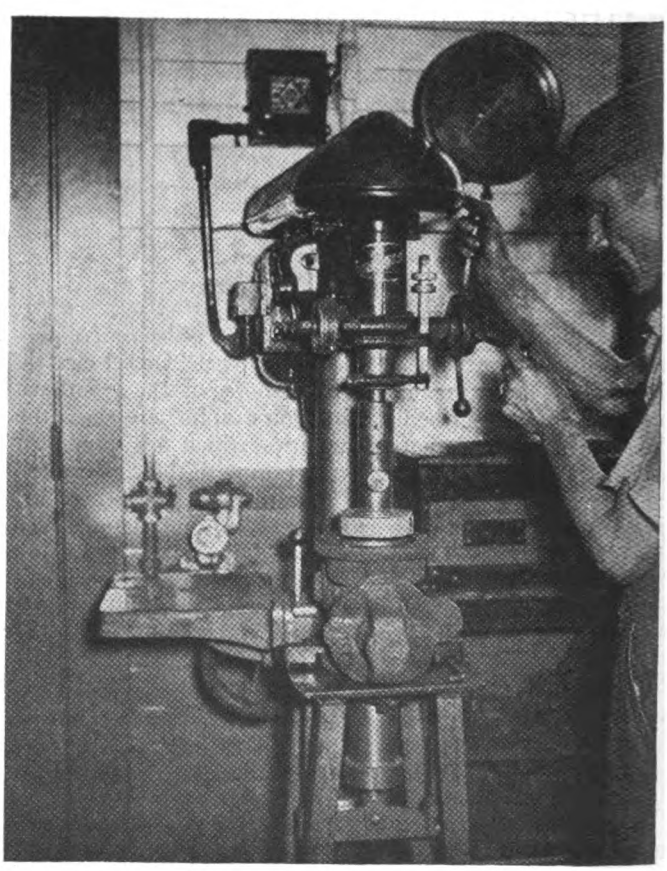
when deterioration reaches a certain degree the hose blows off the nipple.

Physical inspection is made, as indicated in the illustration, with an inspection device consisting of a mirror mounted at 45 deg. near the base of a tube with a small battery lamp behind the mirror to supply the necessary illumination. The tube is inserted into the hose and conditions at the end of the nipples carefully inspected. Hoses that do not show any visible defects are then tested under 125 lb. of air and returned to service if O. K. This method has made it possible to extend the life of air hose in some cases to a point that is hard to believe. The railroad has air hose in service today that has been in operation over twelve years and which was manufactured two to three years before being placed in service.

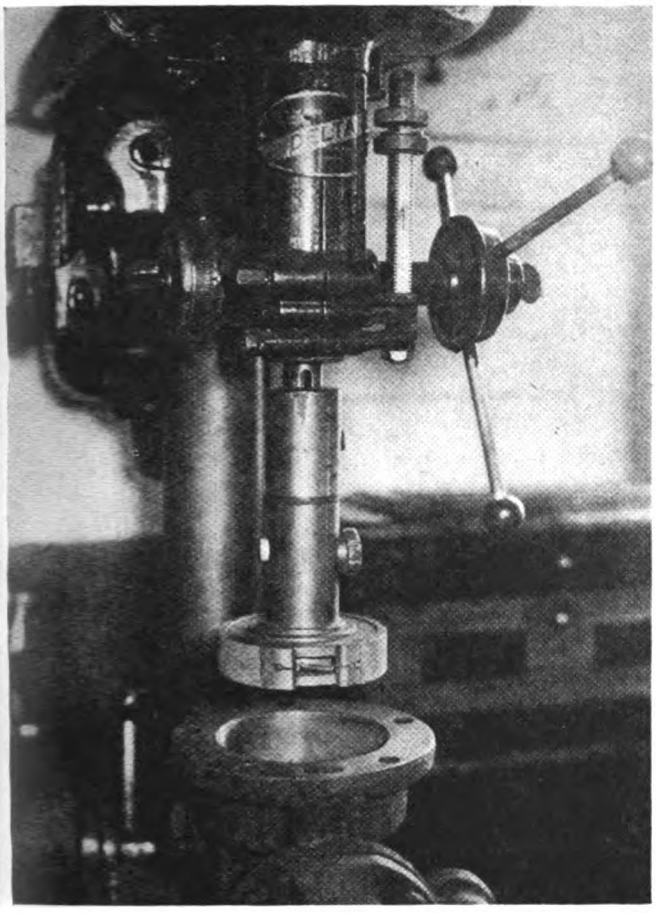
Each Independent System car has 16 hoses of various sizes and lengths, a total of over 27,000, and a large saving of critical rubber has been made in this item alone.

Honing Triple Valve Bushings

Triple valve bushings are honed at the Chattanooga, Tenn., car shops of the Southern with a tool built for use on a drill press. The tool consists of a hollow spindle in which there is a screw-adjusted tapered wedge which serves for making adjustments in diameter on the honing shoes. This is accomplished by expanding a ball-bearing ring, the outer edge of the balls in turn exerting an expanding force upon the inside surface of the honing shoes. The two shoes are connected together and held against the ball race with tension springs. A fine carborundum cloth is used on the shoes. It is applied with a



A specially designed honing tool for triple valve bushings is used on a drill press having a spindle speed of about 400 r.p.m.



The honing shoes are covered with a carborundum cloth which is shellacked in place on the faces of the shoes

thin even coat of shellac and held in place with a retainer ring until the shellac is thoroughly dry.

Honing operations are performed at a drill press spindle speed of about 400 r.p.m. The triple valve bodies are held by an air clamp built by the shop forces and permanently fixed to the drill press base. This mounting does not prevent the use of the drill press for other work.

Specification For Tank Cars–Center Sills

Under date of December 8, the A.A.R. Mechanical Division referred to the question of permissible use of A.A.R. Z-section center sills on tank cars which has been before the Committee on Tank Cars and Committee on Car Construction and said that a center sill composed of two members, A.A.R. Z-26 section, total weight 82.4 lb. per ft., having a total area of 24.24 sq. in., is acceptable as an equivalent of the built-up type sill of 30 sq. in. area, as required in the A.A.R. Specifications for Tank Cars.

Therefore, Par. 2(d) Sec. H-Car Structure of the A.A.R. Specifications for Tank Cars, is modified to read as follows:

2(d) Center Sills.—The center sill construction must meet the following requirements:

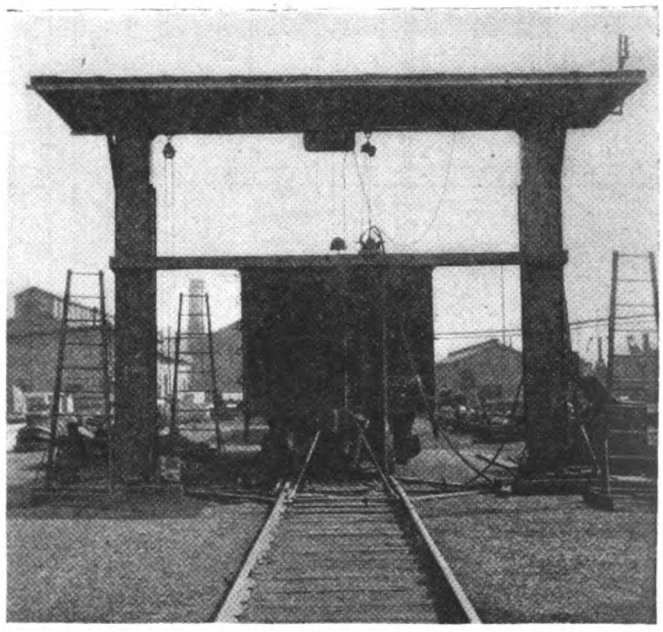
Minimum center-sill area between points of impact, 30 sq. in. Note—A center sill composed of two members, A.A.R. Z-26 section, total weight 82.4 lb. per ft., having a total area of 24.24 sq. in. is acceptable as an equivalent of the built-up type sill of 30 sq. in. area as specified above. Ratio of unit stress to end load for center sills, not more than 0.05. Ratio of unit stress to end load for draft attachments, not more than 0.125. Length of center- or draft-sill members between braces must be not more than 20 times the depth of member, measured in the direction in which buckling may take place. Continuous sills are preferable; sills other than Z-26 to have a cover plate. Other center sill construction or materials, when approved for tank cars, may be used.

Car Body Straightening Stall

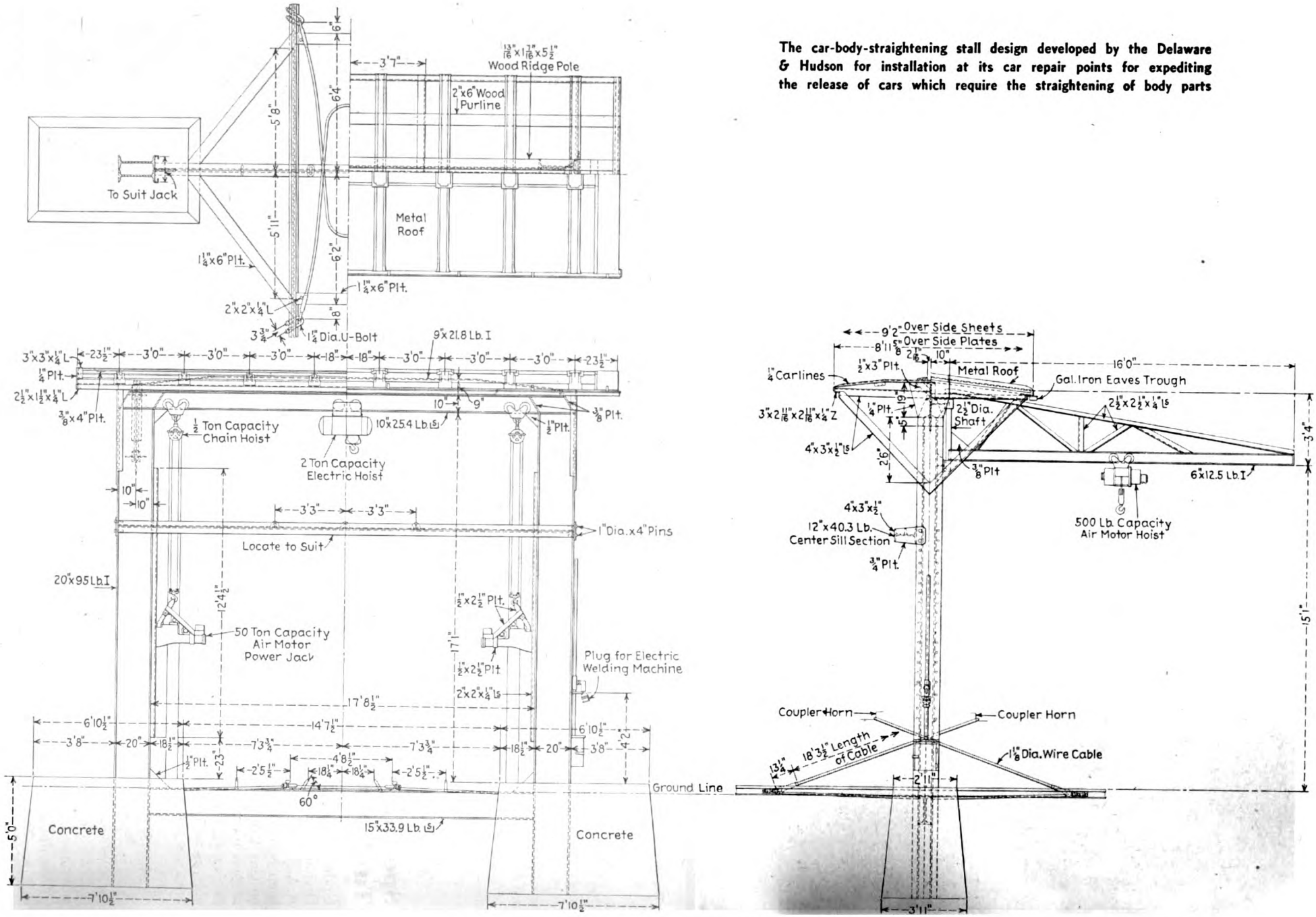
A car-body-straightening stall recently erected at the Oneonta shops of the Delaware & Hudson has proved to be so satisfactory that the railroad is installing similar stalls at each of its major car repair points. The shop forces have found it possible by the use of the stall to release many cars to service that formerly would have required more or less complete stripping to straighten bent body members or center sills. The photographs and drawing illustrate the essential construction and operating features of the stall.

The force required to straighten car parts is obtained through the use of 50-ton air-motor jacks which are suspended from chain hoists and move vertically in sliding ways on the stall side posts when used for straightening top rails, side stakes, side sills and center sills. If end bulb angles or end gates require straightening the jacks are mounted against a stress member which is fastened in position on the side posts. A variety of heads can be mounted on the end of the ram of the jack to suit the contour of the part being straightened.

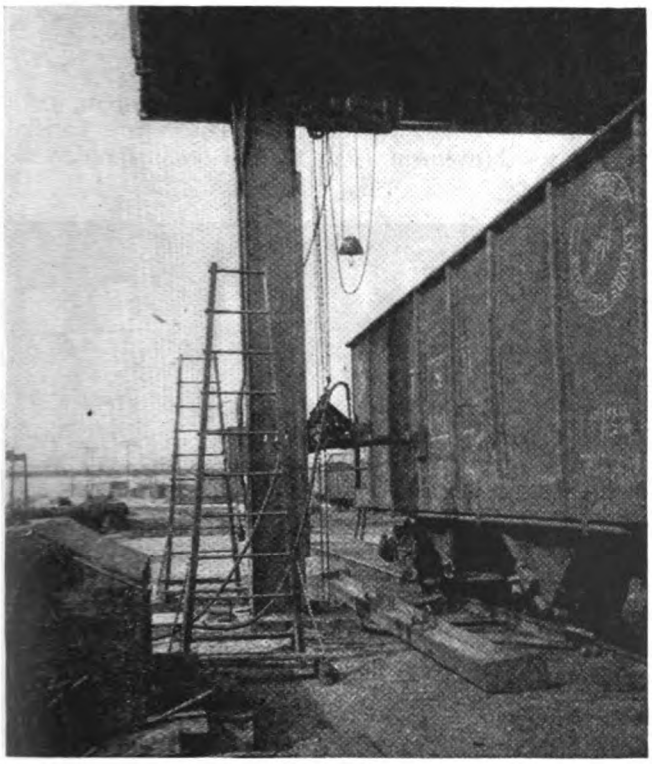
Although wreck-damaged cars in which center sills have been sprung or bent can and have been straightened successfully with considerable saving in time, the bulk of the work done in the stall has been in straightening spread sides on open-top equipment and in straightening bulged car ends. This last has been particularly important in



Crossbar and jack in position for straightening an end bulb angle



The car-body-straightening stall design developed by the Delaware & Hudson for installation at its car repair points for expediting the release of cars which require the straightening of body parts



The head used in straightening side stakes

enabling the D. & H. to maintain required hand-brake-wheel clearances with a minimum of out-of-service time for cars which require only this attention.

When side stakes or other parts on the side of the car are to be straightened because of a bulge, the car is first positioned in the stall opposite the jack heads. The jack on the side opposite the bulge is operated first until its head contacts the car side, stake or sill opposite the member requiring straightening. With this in place to hold the car for the exercise of a straightening force, the opposite jack is advanced sufficiently to straighten the damaged member. In practice the jack is advanced to a point where a slight reverse bend appears in the member to compensate for springing. Upon release of the pressure this reverse bend disappears. The skill required to estimate the correct degree of "over-straightening" is quickly acquired. If it is necessary to straighten sides or other members which have been bent inward, the straightening jack is released from the sliding ways on the stall post and operated against blocking inside the car to press out kinks.

Straightening on the ends of cars is accomplished by holding the car in position against the force exerted from the jacks with a steel wire cable which is anchored to the rails and looped over the coupler horn. With the jacks mounted on the cross member which is fastened to the side posts, bulges or kinks are easily removed. Bent corrugated-type end gates on gondola equipment are also straightened by this method using a special head on the jack. Holding clamps prevent the door from being broken loose from the end-gate locks.

A most important time-saving advantage of the stalls was discovered when an attempt was made to readjust a shifted load of lumber which, otherwise, would have required transferring. The necessary adjustments were made in several hours and the load of lumber restaked; transferring the load would have required from two to three times the number of man hours.

Journal Box Inspection and Lubrication

As officially announced, the A. A. R. Mechanical Inspection Department has made an investigation of practices being followed by the railroads and private car lines in connection with inspection and lubrication of journal boxes. Unsatisfactory conditions have been found at repair tracks and shops visited, the most predominant irregularities being as follows:

1—Packing in storage not properly saturated.

2—Improper waste reclamation, lumps, rolls, etc., not removed and packing not in proper resilient condition.

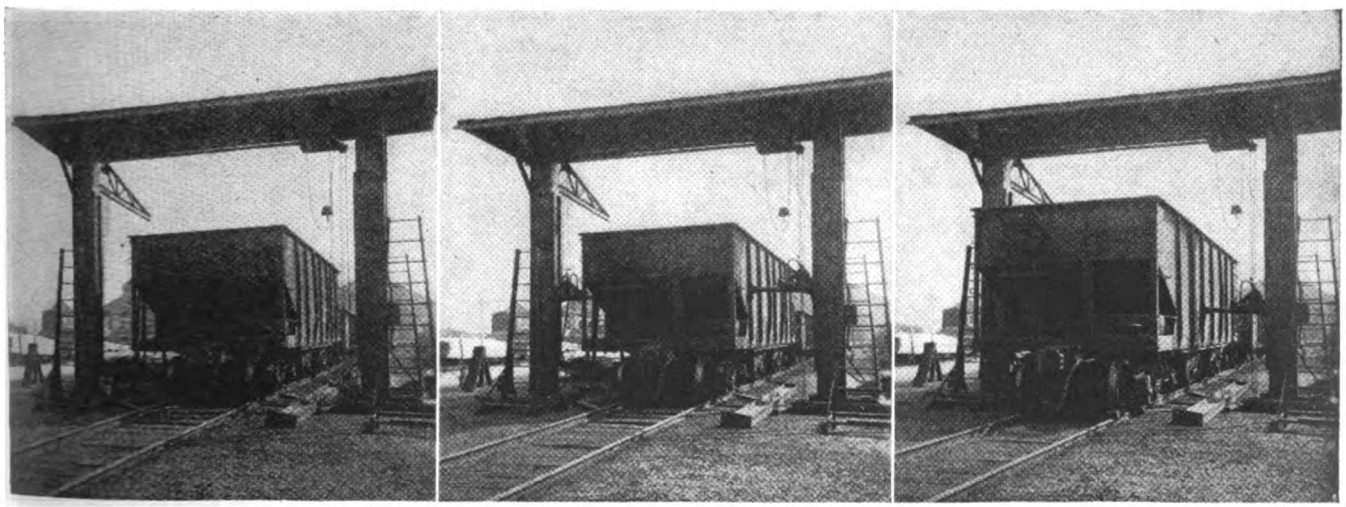
3—Supply of packing exhausted and cars over-due for periodic inspection and repacking, forwarded in service without necessary attention.

4—Excess amount of free oil used during periodic attention.

5—Interior of journal boxes not properly cleaned prior to repacking.

6—Improper reclamation of journal bearings, resulting in loose lining and other irregularities.

7—Missing or defective dust guard plugs not renewed during periodic attention or in connection with wheel exchanges.



Left: Hopper entering stall—Center: Jacks in position to straighten a side stake—Right: Taking out bulge in a side sheet and straightening a stake

8—Loading of cars where journal boxes are over-due for periodic attention.

9—Improper storage of journal bearings, resulting in injury to bearing surface.

10—Packing irons with short blades.

11—Flat condition of wedges not determined during periodic inspection.

12—Missing, loose fitting or otherwise defective journal box lids.

13—Journal bearings worn out.

14—Tendency of permitting packing too high, above 1 in. below center line of journal, frequently found to be up against bearing immediately after periodic attention.

15—Inspection and conditioning of journal boxes on inbound movement, with no further attention prior to train departure to correct conditions that may result from gravity yard or hump switching, weighing of cars and other yard handling, and reverse movement of trains.

16—Packing in boxes contaminated with water, dirt, sand, gravel, wood, rags, rust, and other foreign matter.

17—Packing in boxes dry, not evenly distributed, rolled and up against the journal bearings, worked forward and up against journal box lids, and exeessive or insufficient.

18—Practice to work front of journal box only, rather than follow through with the packing iron.

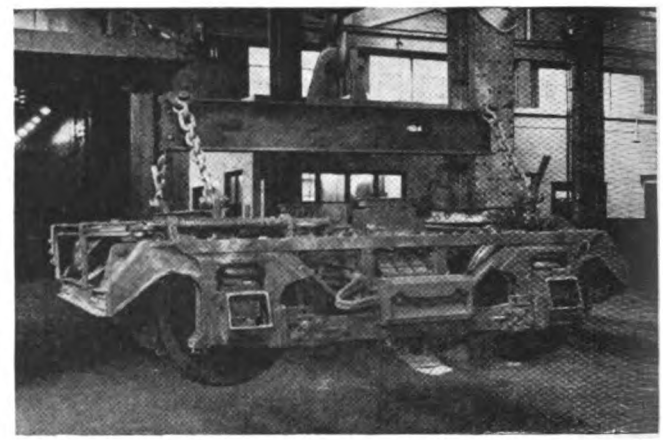
19—Waste grabs under journal bearings on cars lined up in trains O.K.'d and ready for departure.

The purpose of the circular letter calling attention to unsatisfactory conditions existing and irregularities is to suggest that each railroad and private car owner make investigation at his own shops and repair tracks and take immediate action to insure compliance with the present rules and standards, instead of waiting until each individual railroad and private car owner's facilities are investigated by the A. A. R. Mechanical Inspection Department.

Conditions noted by the inspectors in the field indicate that where lubrication and inspection of journal boxes are followed closely, a better than average performance has resulted. The circular states that, where this work is neglected or improper methods and conditions are detected, invariably the results are an increased number of hot boxes with resultant delays, damage and expense.

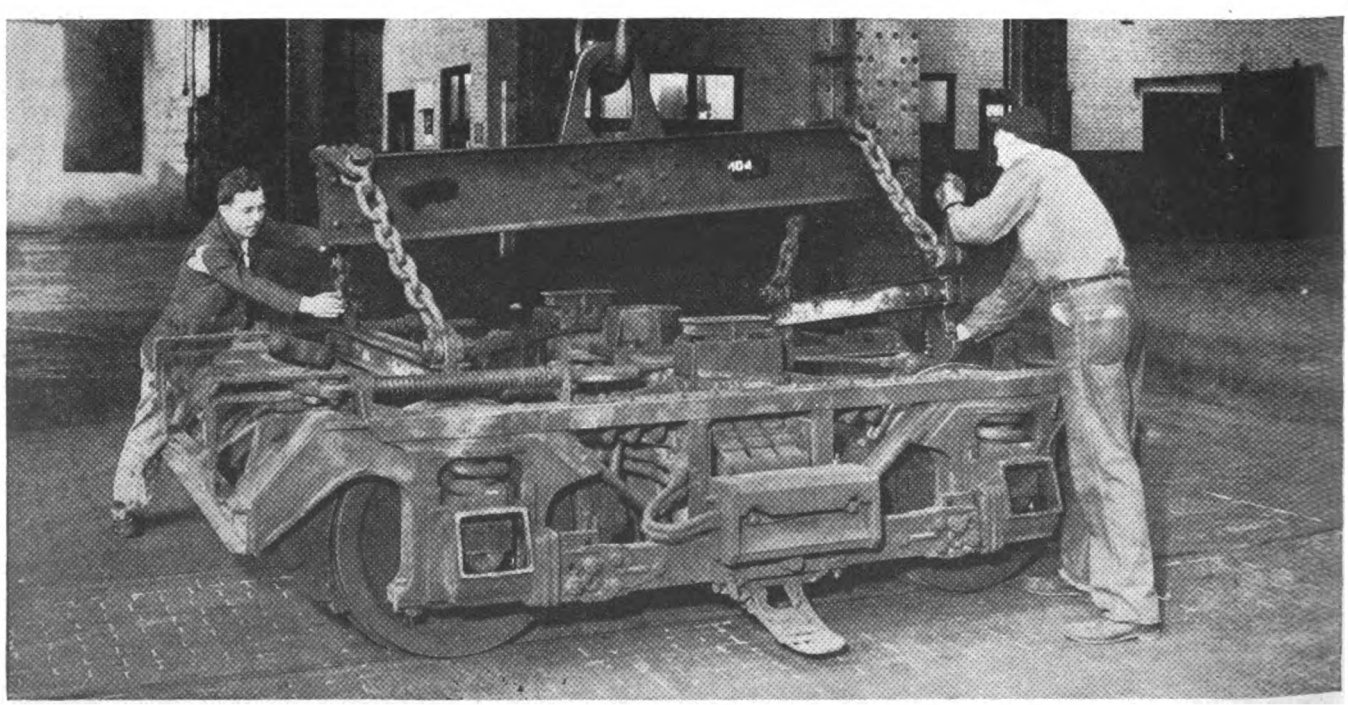
Sling For Lifting Trucks†

In the shops of the New York City Transit System, which maintain 1,700 cars, a great many trucks are handled every day. Movement from the car-body shop to the truck shop and to the various bays in the main shop made it necessary to have a quick, reliable method for handling them. The sling illustrated enables two men to prepare a truck for movement in the matter of seconds instead of the usual time required if chains, wedges, etc., are used. This fixture picks up the truck by the inside of the throat of the wheel and therefore does not disturb the relationship of any of the truck parts such as journal bearings, keepers, springs, bolsters, etc., because the reaction is through the wheel. The cam action on one side of the sling makes it impossible to drop a truck.



When the track is raised the reaction is through the wheels the same as when standing on the track

† Abstract from a paper by B. F. Cordts, engineer, cars and shops, New York City Transit System, presented at a meeting of the Transportation Group, A. I. E. E., New York, on November 14, 1944.



The lifting hooks are slipped inside the throat of the wheel and are held in position by the pull of the lifting chains

Clean Air For Passenger Cars

By W. M. Hutchison*

Precipitron electro-static filters in regular railroad service have removed 90 per cent of the dust passing through them

REMOVAL of fine air-borne dust particles makes possible economies in the maintenance of interior finishes and furnishings not previously obtainable; and during a period of 18 months' operation on two streamliners they have afforded definitely increased passenger comfort. Tests made during the period of operation showed that the Precipitrons removed 90 per cent of the dust particles brought into the car.

Before the development of the Precipitron, no practical method had been devised to effectively rid the air of very small dirt particles. The size of such particles is commonly measured by a minute metric unit known as the micron. A micron is equal to about 1/25,000 of an inch. As an illustration, a particle one micron in diameter when magnified 25,000 times would be approximately one inch in diameter, somewhat smaller than a golf ball. Sizes of dirt particles found in the air in motion range from heavy industrial dusts of 8,000 microns down to tobacco particles as small as 1/10 of a micron. Mechanical filters are effective in removing the larger particles, that is, diameters of about 5 microns or more, but they are not effective in extracting the very fine particles which actually make up from 80 to 90 per cent of the total and which are less than one micron in diameter. The only effective method known today to remove these very fine particles from an air stream is by electrostatic precipitation.

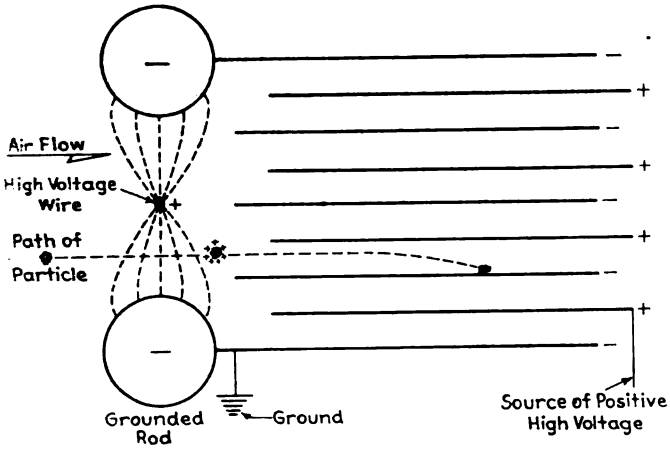


Fig. 1—Principle of operation of the Precipitron

One of the earliest practical applications of this principle was made early in the present century in the Cottrell precipitator, which has been eminently successful in such highly specialized applications as boiler and smoke stacks, and in reclaiming valuable dusts and particles in industry. However, the high voltages used in the Cottrell system, from 30,000 to 100,000 volts, cause such a high generation of ozone that the air thus treated is not safe for breathing and hence not suitable for ventilating systems. The Precipitron, on the other hand, operates at voltages which generate so little ozone that its concentration is in the order of that found out-of-doors on a bright, sunny day. A further advantage is that the Precipitron requires but 1/50 the space for installation that the Cottrell cleaner does for a given volume.

The principle of operation is indicated in Fig. 1. Essentially a screen of electrons and ions is set up in the area at the left of the diagram, through which air-borne dirt particles pass, and in so doing pick up an electrostatic charge. The top and bottom circles at the left represent grounded rods and the solid dot between them the ionizing wire. The electrostatic field is set up between the ionizing wire and rods; air flow is from left to right. The charged particles are carried by the air until they come under the influence of the collector plates which are of opposite polarity and are represented by the horizontal parallel lines. Since unlike electrical charges attract each other, here they are drawn out of the air stream and deposited on the plate. More than 90 per cent of particles down to 1/10 of a micron are captured by this electrostatic precipitation.

The development of the Precipitron for installation in the air-conditioning system of railway passenger cars follows its widespread use for several years in industrial, commercial and domestic application. It is used, for example, to clean the ventilating air for large rotating electrical machinery in steel mills, power plants and substations. Dirt on the windings of such machines can cause excessive temperature rise or leakage over the insulation, resulting in breakdown. In telephone exchanges the Precipitron contributes to improved operation and reduced maintenance by removing the microscopic dust particles

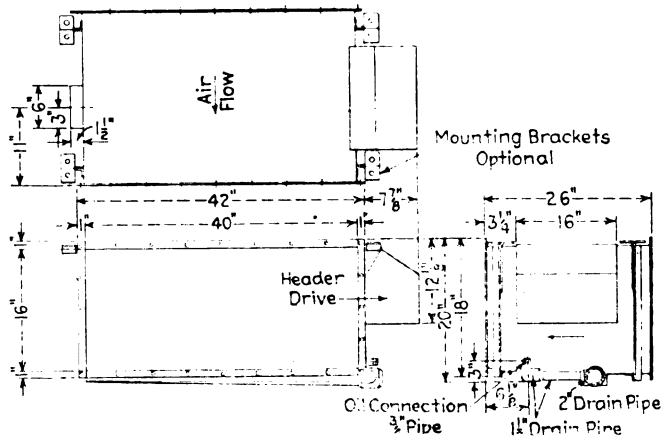


Fig. 2—Outline dimensions of a unit designed for mounting in a passenger car

* Transportation application engineer, Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.

which can interfere with delicate relays and thereby produce noise in the circuits. It is used for cleaning the air in pharmaceutical and chemical plants where the slightest microscopic specks cause impurities in products and im-

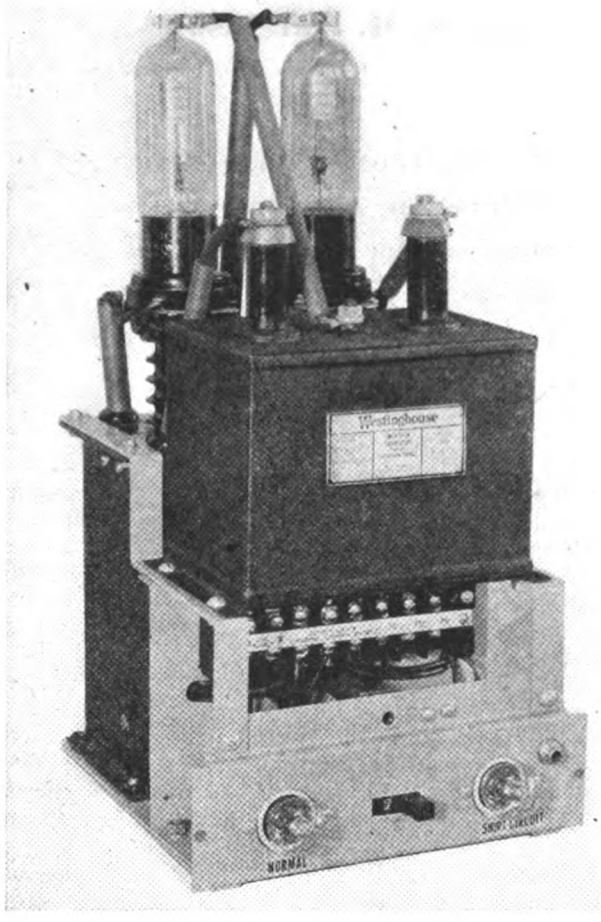


Fig. 3—Power pack used for producing current for the plate circuit and ionizer circuit

perfections in processes. It is used to obtain relief from annoying and costly air-borne dirt, dust, soot and smoke which soil and damage merchandise in stores and shops and cause frequent redecorating and cleaning expense. As its contribution to war production, it is used where precision parts, instruments, lenses and optical goods are manufactured, inspected and assembled. Tiny, unseen abrasive and corrosive particles that damage super-finished surfaces can not be removed by mechanical filters. Yet the Prescipitron takes them out of the air and saves many costly rejects.

Not only is the Precipitron more effective than any other cleaner in removing dirt but it also has the additional important advantage of smoke removal. That is, in passenger cars equipped with a Precipitron, it is possible to permit indiscriminate smoking throughout the car without annoyance to passengers who do not smoke.

The introduction of the Precipitron into the field of air-cleaning rendered obsolete accepted testing methods conducted on a weight basis. These tests used an artificial dust arrangement, whereas cleaning devices are usually installed to clean normal atmospheric air. A blackness or discoloration test, therefore, provides greater accuracy, approximates the actual particle count and is made without the addition of any artificial dust. As the air is drawn through the intake of the integrating blackness tester, it passes through a filter paper placed over the intake. Provision is made for accurately measuring and adjusting the air flow. Samples of dust deposits are taken both before and after passing through the Precipitron. By comparing the time required to obtain spots of equal blackness at intake and exhaust, the efficiency of the air cleaner is determined accurately.

A comparison of the results of the weight test with the blackness test shows these interesting facts: The efficiency of the Precipitron by the weight test showed well over 99 per cent; by the blackness test 90 per cent at 300 ft. per min. Under the same test most mechanical filters are but 10 to 20 per cent efficient.

Design for Passenger Cars

Although the principle of operation of the Precipitron as applied to railway cars is the same as for commercial applications, its physical design differs radically. The commercial Precipitron is rated at a linear velocity of 300 ft. per min. for a blackness test of 90 per cent. To meet the severe space limitations of railway car application, the Precipitron must operate at a linear air velocity of 600 or more ft. per min. Under this condition, the efficiency is retained by decreasing the spacing between the collector plates and by keeping the plates well coated with adhesive. The decrease in spacing of the plates results in a corresponding decrease in dirt-holding capacity. It is obvious then that if the Precipitron can be relieved of the large particles of dust and dirt which are taken into the system of the fresh air supply, the time between successive cleaning periods of the Precipitron can be greatly extended. The best mechanical filters can do this satisfactorily; however, they become dirty and present a maintenance problem as they must be taken out of the car and either thrown away or cleaned, reoiled and replaced. If they are not well maintained, they become so clogged

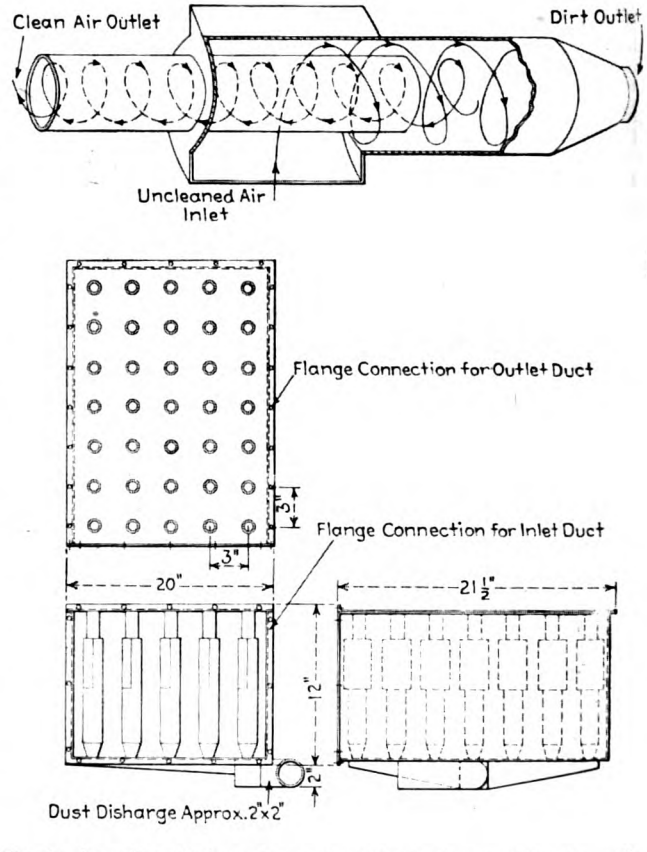


Fig. 4—An enlarged view of a vortex tube is shown at the top and a complete precleaner, including 35 tubes, is shown below

with dirt that little, if any, air passes through them. To obviate this objectionable feature the Precipitron air-cleaning system for railway cars includes a fresh air precleaner of the mechanical cyclone type. This removes heavy road dust and cinders from the fresh air stream and discharges them from the car on a continuous self-cleaning basis.

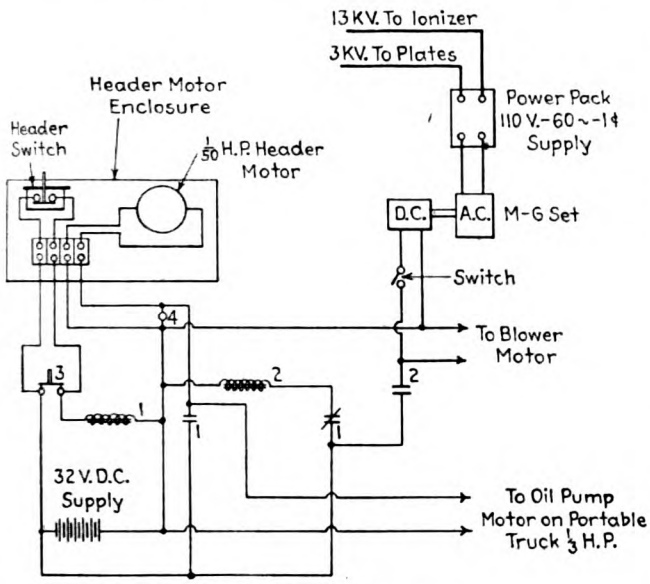
The Precipitron consists of three major parts: the dust collector cell; the ionizing unit; and the power pack. The dust collector cell and ionizing unit are assembled together in one framework. The outline dimensions of the unit with a capacity of 2,400 cu. ft. of air per min., are shown in Fig. 2. The power pack unit, mounted separately, is used to change the alternating current supply to direct current of suitable voltage to charge the ionizers and collector cells. It includes a small transformer and rectifier tubes and capacitors arranged to provide approximately 3,000 volts direct current to the plate circuit of the collector cells and 13,000 volts direct current to the ionizer circuit. Fig. 3 shows the general appearance of the power pack unit.

The precleaner is made up of a number of vortex tubes, as shown at the top of Fig. 4, which throw the dirt particles out of the air by centrifugal force and expel them from one end of the tube while the clean air passes out of the other end. Ninety-five per cent of the air which passes through the precleaner is delivered to the car interior. The remaining five per cent is used to expel the dirt particles from the cleaner and dump them overboard. Thus the Aerotec unit is self-cleaning and requires no maintenance. Fig. 4 also shows an assembly of 35 such tubes arranged for installation in the fresh air supply with a capacity of 600 cu. ft. of air per min. The assembly operates at approximately 1½ in. static pressure and utilizes a fan, operated by a ½-hp. motor.

The power requirements of the Precipitron itself are very moderate, totaling approximately 1/10 hp. An alternating current source is necessary to operate the power pack. This may be provided at either 110 or 220 volts by a small motor-alternator if no other source of alternating current power supply is available. A typical schematic diagram for railroad car application is shown in Fig. 5.

Periodic cleaning is necessary to remove the accumulation of dirt from the Precipitron plates. Oil is used for cleaning so that the plates are automatically coated with adhesive as they are cleaned. Two systems are available. One, the car system, provides for mounting complete cleaning equipment on each car; the other, the wayside system, provides for cleaning from wayside facilities.

The car system provides for cleaning at the throw of a switch. The Precipitron is assembled in a casing with a suitable drain. Above the plates there is a nozzle with a suitable mechanism to move it back and forth across the



1—Two pole s.t. 32-volt relay
2—One pole s.t. 32-volt time delay relay
3—Momentary push button switch (norm. off)
4—Red indicating light

Fig. 5—A schematic wiring diagram for railroad car application

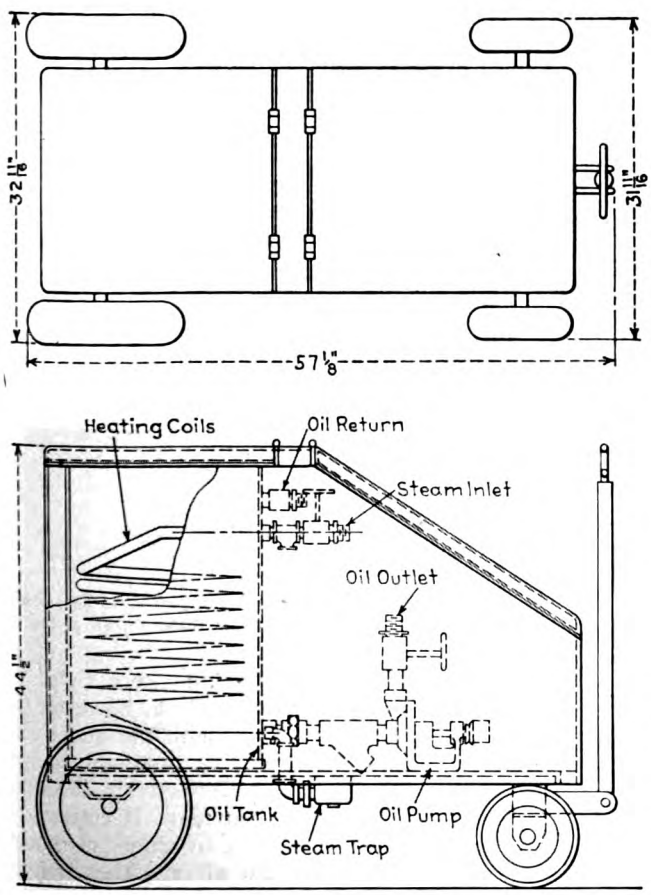


Fig. 6—The buggy used at terminal points for cleaning Precipitrons

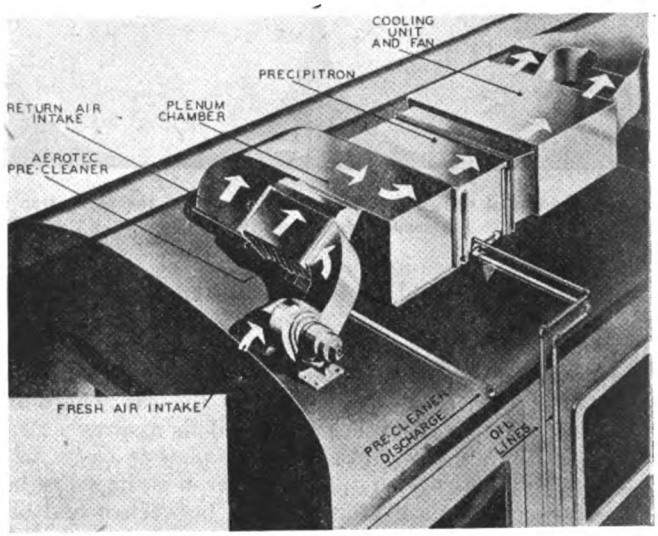


Fig. 7—Phantom drawing of a complete unit as applied to a car

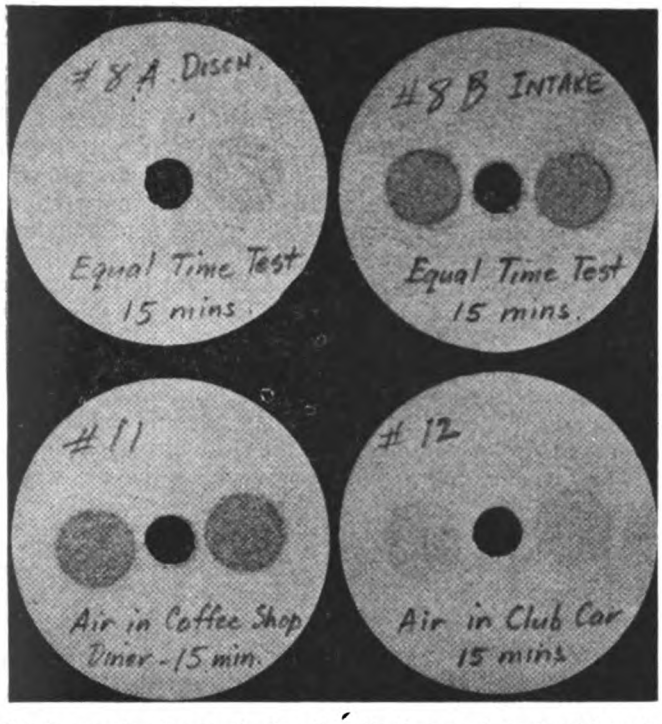


Fig. 8—Results of tests showing the effectiveness of the Precipitron in removing dust from the air

width of the Precipitron. A reservoir of oil, a motor-driven pump to circulate the oil and suitable oil feed and drain lines complete the system. An electrostatic oil cleaner is included in the oil reservoir. This cleaner removes the collected dirt from the oil and deposits it as sludge in hoppers in the bottom of the car where the sludge may be drained periodically. This assures a clean supply of oil for each flushing of the plates.

In the wayside system, the Precipitron is the same, but the oil feed and drain lines are run between it and terminals at a convenient place at the side of the car. The oil reservoir, pump and oil cleaner are built into a portable unit for movement about the car yard. To clean the Precipitron this unit is connected to the oil lines at the side of the car. After a proper interval the unit is disconnected and moved to the next car. Fig. 6 illustrates the construction of such a cleaning buggy. A skeleton view of a complete installation of a Precipitron and precleaner and horizontal air duct above the car ceiling is shown in Fig. 7.

In November, 1941, efficiency tests were made of Precipitron units in the two streamliners during a long round trip. The tests were made with the integrating blackness tester. The tests made at intervals during the trip showed an efficiency of 90 per cent or better. Other comparative tests were made during the trip by sampling air at various points. The results of two such tests are shown in Fig. 8. Each test consisted of drawing air through the filter papers for 15 minutes. Sample 8-A was taken from the clean air discharged from the Precipitron, and sample 8-B was taken from the air entering the Precipitron behind the mechanical filter in the fresh air supply. Sample 12 was taken from the air in the club car equipped with a Precipitron, and sample 11 was taken from the air in the coffee shop diner, a car which has the same type of air-conditioning system as the club car except that it was equipped with mechanical filters only. Both samples 11 and 12 were taken at a time when the cars were well occupied and many passengers were smoking. The effectiveness of the Precipitron is readily apparent as the samples show the air in the club car to be much cleaner than the air in the coffee shop diner.

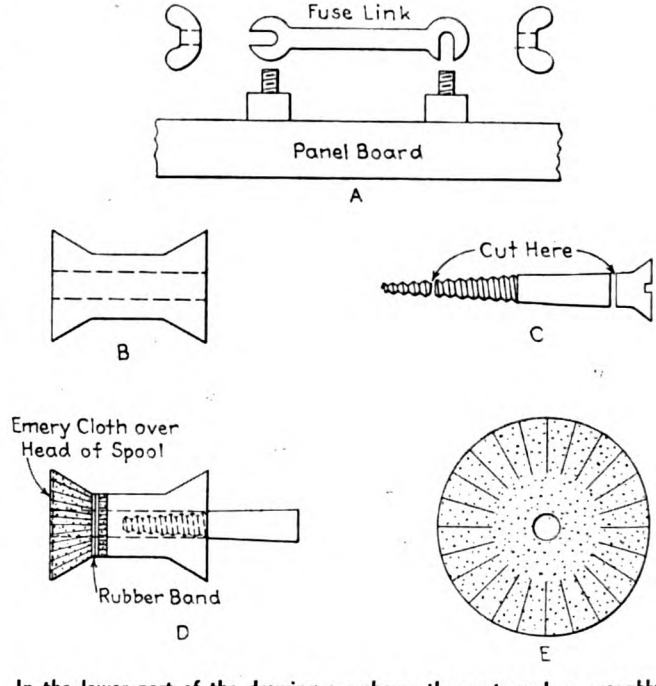
By removing the fine particles of dust which escape the ordinary mechanical filter, the Precipitron keeps the car cleaner than any other system of air cleaning, thus making possible economies in maintenance of passenger car equipment not previously obtainable. Interior finishes remain fresh and clean for extended periods as do also interior furnishings, including upholstery and window drapes when used. This assures additional comfort and attractiveness to the passenger. The application of a mechanical self-cleaning precleaner eliminates the maintenance of fresh-air filter of the oil or throw-away type.

In many instances the Precipitron can be applied to existing air-conditioned cars by modifying the air duct. Installation in new cars can be readily made since space can be provided for when the car is being designed.

Fuse Contact Insurance

If fuse contacts are loose, corroded, or out of shape, the heat generated by contact resistance added to the heat generated in the fuse itself by load current will frequently cause a fuse to blow, causing road failures, when everything else is operating properly. The device shown in the illustration was made specifically for the fuse studs on motor-control panels of Safety-Carrier air-conditioning equipment.

These panels have four sets of fuses, or 16 fuse contacts, in the form of binding posts or studs with protruding threads. Good contact is assured if surfaces are



In the lower part of the drawing are shown the parts and an assembly of a tool used to clean fuse contacts such as those shown at the top

cleaned periodically and the wing nuts kept tight. If they are cleaned by hand with emery cloth, however, the shoulder of the stud which contacts with the under side of the fuse soon gets out of shape. The assembly shown in the lower part of the sketch will effectively clean the stud contact surfaces and keep them flat. It consists of a wood screw, a small spool, a piece of emery cloth and a rubber band. The screw is cut off at either end, as shown, and turned into the hole in the spool. A piece of emery cloth is cut into a circular form, as shown at *E*,

with a hole in the center just large enough to fit over the screw threads on the studs. A number of radial cuts are made around the edge, as shown, and the emery cloth is fitted over the spool and secured by the rubber band, as shown at *D*. The screw is then chucked in a hand drill and used to clean the studs.

Coupler Cable Testing

All types of Diesel-electric locomotives, electric locomotives and multiple-unit cars employing traction motors require cables for control circuits and power circuits between motors and the car body which are subject to constant flexing. Eventually strands in these cables break, and it is desirable to make periodic tests for broken strands and thereby avoid failure.

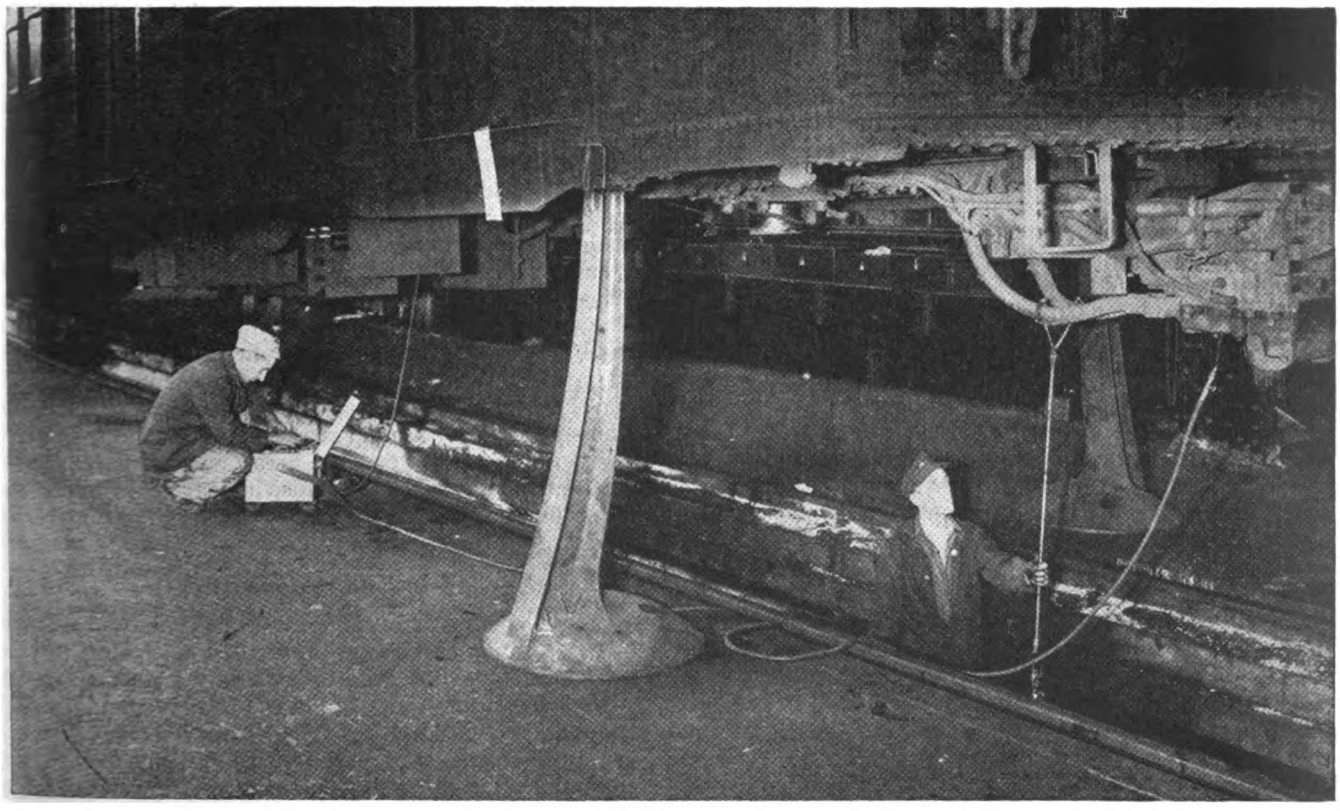
Effective means for making the necessary tests have been developed by the New York City Transit System. These were described by B. F. Cordts, engineer, cars and shops, in a paper presented by the Transportation Group at a meeting of the American Institute of Electrical Engineers held in New York on November 14, 1944, and the following is an abstract from Mr. Cordt's paper:

Various control connections between cars are made through an automatic coupler which has three functions: one to couple the cars mechanically, two to make the air connections, and three to connect them electrically. Multi-conductor flexible cable is used between the electrical portion and the junction box on the car body. Since these cables are subject to flexing by the movement of the coupler, it has been found that wires in these control cables fatigue and finally open-circuit. There are two cables at each end of the car and each cable consists of 16 conductors, all insulated from each other. It was therefore found necessary to find some means to determine the condition of the wires in these multi-conductor cables; and since it is impossible to make a physical inspection of this cable, reliable testing equipment had to be developed.

After many unsuccessful attempts to solve the problem, the method in use at present was developed and found to do the job very satisfactorily. The circuit used is a Wheatstone bridge circuit, in which the wire to be tested from the connection in back of the coupler to the junction box forms the variable leg in the circuit, and a very sensitive light beam galvanometer across the bridge to indicate when the circuit is balanced. All the equipment is contained in the box shown on the floor, mounted on soft rubber bumpers. The light beam galvanometer is a laboratory instrument and must be protected against the rough usage ordinarily found in shops. A mechanical device is then clamped to the coupler cables and, by means of foot power exerted by the man in the pit, the cables are pulled together and separated. Under this action, if any of the strands are broken in the control wire being tested, the balance of the circuit is disturbed and an indication given on the galvanometer. This is true whether the broken strands are pulled apart by the vibration of the cable or whether they were apart originally and are closed by the vibration.

The deflection of the instrument indicates the approximate number of broken strands and, as an indication of its sensitivity, it has been possible to obtain a deflection with only 2 of the 91-28 wires, which make up some of the individual conductors broken. Certain limits of galvanometer deflections have been set to determine when a spare wire should be used in place of one with a number of broken strands.

This test is made in the general inspection period at the shop on approximately a yearly basis. Careful records are kept of each car so that the progress of the potential failure can be followed.



Procedure used for testing multi-conductor control cables

F. C. C. Proposes

Radio Channel Assignments

THE Federal Communications Commission has proposed allocations of radio channels for train communication purposes. These include (1) some joint use of channels below 3 megacycles; (2) for end-to-end communication 33 adjacent channels in the band 156 to 162 megacycles; (3) for yards and terminals, 3 bands in the television band, namely 44-50, 54-78 and 192-216 megacycles (these are to be used on an appropriate geographical sharing and non-interfering basis; (4) for experimental purposes the following: 1900-2300, 3900-4550, 5750-7050, 10500-13000, 16000-18000 and 26000-30000 megacycles. The Commission suggests that already assigned frequencies may prove practicable for the warning of wayside employes but that if they do not, three exclusive channels of appropriate width will be made available for this purpose.

Channels requested by the railroads include six below 3 megacycles, 88 between 100 and 200, 36 above 1,000, and the entire band between 2600 and 2700 megacycles. The Committee's findings are based on investigations made in the field by representatives of the Commission and on hearings held before representatives of the Commission in Washington, D. C.

On January 16, 1945, the Commission issued a report bearing the title "In the Matter of Allocation of Frequencies to the Various Classes of Non-Governmental Services in the Radio Spectrum from 10 Kilocycles to 30,000,000 Kilocycles" (Docket No. 6651). Under the subject of New Radio Services, Section 17, this report lists the proposed allocations to railroads together with a fund of data and information outlining the evidence collected and explaining the reasons for the action of the Commission. This material is summarized in the following:

The Commission is convinced that the carrier current system of operation is not, at present at least, a practicable solution for all communication needs of the railroad industry as a whole. It is felt by the Commission that the cost of installing paralleling wayside wires in locations where they are non-existent or not near track would incur an unwarranted cost; that the use of wayside wires would be impracticable in some metropolitan terminal areas, and that the system in some locations might at times be made inoperable by storms.

In The Public Interest

The Commission is convinced that a properly engineered railroad radio service will contribute to the safety of life and property both in preventing rail accidents and in reducing the seriousness of injury and damage after accidents by permitting the prompt summoning of aid to the scene of an accident.

The report states that the use of radio by the railroads should be of almost universal benefit to the public. To support this information attention is called to the fact that the railroad industry is by far the major transportation service of the nation since freight service performed by Class I railroads for the year 1943 amounted to 730,407,500,000 ton-miles, representing 86.7 per cent of all land borne freight moved in the country, while in the same year the passenger service performed amounted to 87,974,200,000 passenger miles with 891,790,000 revenue passengers carried. "Thus," the report states, "it is clear that the establishment of a railroad radio service which will contribute to the safety and efficiency of these public utilities which play so important a role in our national life will result in a direct benefit to the public."

Experiments and Applications

The testimony in the railroad radio hearing showed that radio communications could be used to advantage by all railroads, in conjunction with the present type of signaling and dispatching employed. At the time of the hearings in this proceeding, 58 separate Class II experimental stations had been authorized for experimentation in the use of radio in connection with railroad operations. Although this experimentation has been confined to about ten railroads, many more are prepared to use radio when a regular service is established for railroad purposes. Thus, on that basis, for example, 40 railroads representing 66.8 per cent of the total mileage have indicated that they will use radio for end-to-end train communication; 42 railroads representing 69.4 per cent of the total mileage have indicated that they will use radio in yard operations; and 39 railroads representing 64.3 per cent of the total mileage have indicated that they will use radio in terminal operations. Many other railroads also expressed interest in these services and it seems probable that the proposel railroad radio service will receive a very general use, once established.

Proposed Allocation

The railroads requested six channels below three megacycles. Four of these, namely, one channel at 375 kilocycles and three from 400 to 500 kilocycles were for use from ship-to-shore and in coastal harbor services. No allocations were made for these since the railroads did not request exclusive use of these frequencies. The other two were for 2318 and 2342 kilocycles to be used for emergency purposes. The railroads have not requested the use of these frequencies on an exclusive basis and the report states that adequate provision can probably be made for such emergency requirements.

In the portion of the spectrum between 100 and 200 megacycles, 88 channels were requested for railroad use. The distribution of the 88 channels requested in this band was roughly as follows: one-third for end-to-end, train-to-train and fixed point-to-train communications; one-third for communications in yard areas where freight trains are broken up and reassembled; and one-third for communications in terminal areas where interchange of cars between various railroads, industrial switching and other operations are performed by a large number of roads.

End-to-End Communication

A total of 26 channels were requested for end-to-end communication and it is the Commission's feeling that the full development of end-to-end communication service within the railroad industry will probably require the 26 channels requested.

The channels requested for use in end-to-end train communication are also to be employed in fixed point to moving train operation for communicatin between train crews and fixed point personnel in the direction of main-

line trains. In directing the movement of trains, long instructions are issued at times and, for that reason, it is necessary for the train crew to be able to "break" the director during the conversation in case of an emergency or any misunderstanding of the instructions being issued. To provide this break-in service, six channels were requested to take care of the cases where six individual railroads paralleled each other, but where this important break-in service would have to be provided on a non-interfering basis for each of these railroads. The six break-in channels, 120 kilocycles wide, were requested in the 159.12 to 159.84 megacycle band so that they would form a continuous band with the 26 end-to-end frequencies in the 156 to 159.12 megacycle band with which the break-in channels would be associated in use.

Thus, for communication between the front and rear end of trains, between trains and railway employes on the ground, between passing trains and between fixed points and trains, a total of 32 channels, 120 kilocycles wide, were requested in the band 156 to 159.84 megacycles. As previously noted, these services require interference-free channels because of the movement of trains over long stretches of country. Accordingly, it is proposed to allocate 33 adjacent channels in the band 156 to 162 megacycles. As in the case of other services in this portion of the spectrum, an average channel width of 60 kilocycles is assumed. It is further assumed that adjacent channels will not be used in the same area.

Attention is also called to the fact that the band 102 to 108 megacycles is not being assigned at this time. This makes it possible for the Commission to allocate this band at a future date to the services having the greatest need therefor, and in this connection the needs of railroad radio will be given careful consideration. Similarly, the television channel between 78 and 84 megacycles may also be available at some future date if television vacates this portion of the spectrum.

Yard and Terminal Service

For communication in yard operations 20 channels 100 kilocycles wide have been requested by the railroads in the band 133.85 to 135.85 megacycles. This request was based on the situation existing in the most congested area, the Chicago terminal district, containing 122 separate yards. Under the proposed allocation, the following frequencies in the following television bands are made available for assignment of the 20 railroad yard communications channels requested upon an appropriate geographical sharing and non-interfering basis: 44-50, 54-78 and 192-216 megacycles.

For communication in terminal operations, 33 channels each 100 kilocycles wide, have been requested by the railroads in the bands 116-116.4, 116.6-117, 133-133.8 and 137-138.7 megacycles. The estimate of 33 channels corresponds with the number of railroads operating in the Chicago terminal district. Sixteen of these railroads have asked for allocations and it is the judgment of Committee 7, Panel 13, Radio Technical Planning Board, that within a reasonably short time after the establishment of railroad radio service, all railroads operating in the Chicago district will find it desirable to utilize radio for terminal communications.

Although a wider communication range is requested for terminal operations than for yard operations—as much as 35 miles in some terminals—the localized nature of terminal operations permits the same allocation treatment to be made of the channels requested for terminal operations as has been outlined for yard communications. Accordingly, it is proposed to allocate the 33 channels requested for use in terminal operations from among the frequencies in the television bands not used in the particular areas where the terminal communications are to take place. Under the proposed allocation, frequencies in the following television bands are made available for assignment for railroad terminal communications upon an appropriate geographical sharing and non-interfering basis: 44-50, 54-78 and 192-216 megacycles.

For warning employes who must work on or near tracks, three channels 120 kilocycles wide were requested in the band 159.84 to 160.20, 20 megacycles. Since these services require only short range operation the Commission believes the railroads can safely use for this purpose frequencies allocated for other railroad services without risk of interference. For that reason the Commission does not propose to allocate any separate frequencies for this wayside warning service. If it appears that such sharing is not feasible, three exclusive channels of appropriate width will be made available.

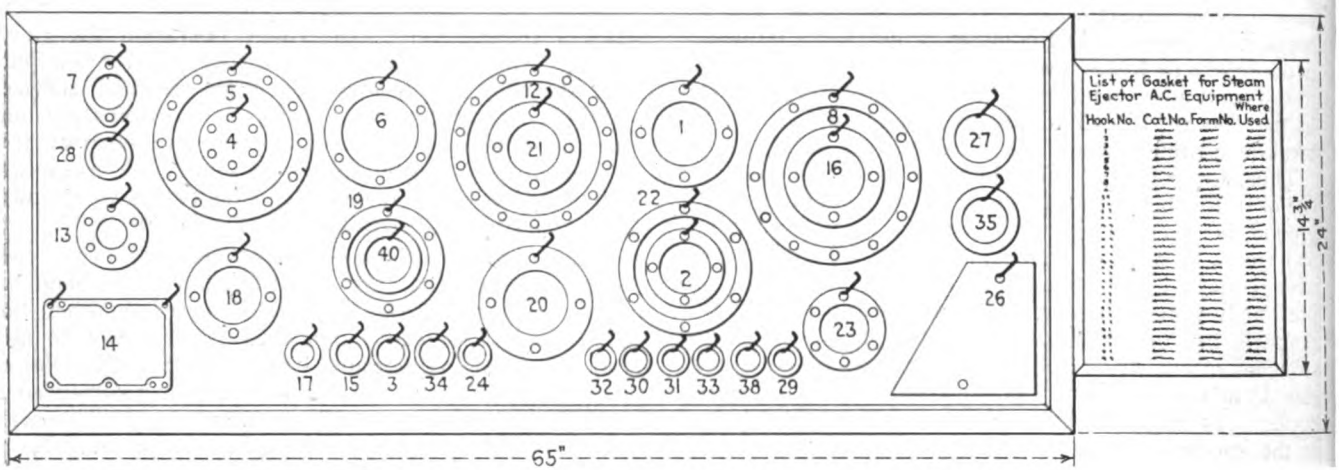
In the portion of the spectrum above 1000 megacycles, 36 channels between 1000 and 1090 and in the band between 2600 and 2700 megacycles were requested for railroad use. Eighteen channels 2.5 megacycles wide have been requested in the band 1000 to 1045 megacycles to provide a radio relay service for wayside to train communications in the fixed point to moving train service where the desired range of communication may be as much as 300 miles. In the absence of such a relay system this range of communications would of course be unobtainable at the very high frequencies (156-162 mc) proposed to be allocated to this fixed point to moving train service.

Eighteen additional channels 2.5 megacycles wide have been requested in the band 1045 to 1090 megacycles for remotely controlling centralized traffic control systems. In addition to the radio relay and remote control channels requested above 1000 megacycles, the railroad industry has requested the assignment of the entire band 2600 to 2700 megacycles for the continuation of experiments in the microwave region. The Commission is not proposing permanent assignments to the railroads in this range since there seems little possibility of obtaining equipment on a commercial basis until after the war. Experiments conducted by the Chicago, Rock Island & Pacific, however, indicate important potentialities in these frequencies, and the Commission hopes that all roads will give every consideration to further experimentation at these frequencies.

Under the proposed allocation, therefore, the following frequency bands above 1000 megacycles will be available to the railroads and others, on an experimental basis, for the development of radio relay, remote control and other services for which the 2600 to 2700 megacycle band was requested on a permanent basis, namely, 1900-2300, 3900-4550, 5750-7050, 10500-13000, 16000-18000 and 26000-30000 megacycles.

It is the opinion of the Commission that the foregoing proposed allocation for railrad radio services is adequate for all purposes. Further, it is hoped, in the light of the evidence adduced at the railroad radio hearing regarding the improved safety and efficiency facts attendant upon the use of radio in railroad operations, that the railroad industry will make the fullest possible use of the frequencies proposed to be allocated as soon as materials are available. Finally, it should be noted that it is the Commission's obligation under Section 4 (k) of the Communications Act of 1934, as amended, annually to "report to the Congress whether or not any new wire or radio communication legislation is required better to insure safety of life and property." In conformity with that obligation, the Commission will continue to study the progress made

by the railrads in the application of radio to their operations. Therefore, although the issuance of this proposed report in this proceeding, Docket No. 6651, looks also to a conclusion of the Commission's docket proceeding No. 6593,* the Commission will, if necessary, hold further hearings on the subject of the application of radio to railroad operations.



Air-conditioning gasket and identification board

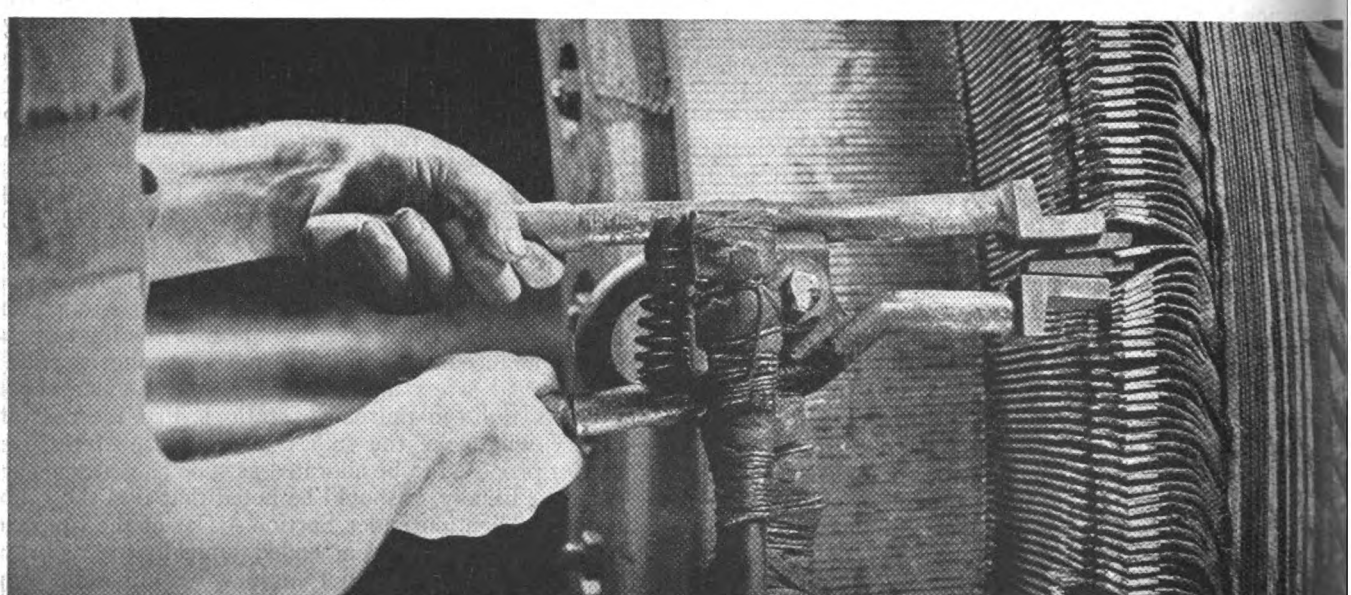
Gasket Board

A wide variety of gaskets are used on Safety-Carrier steam jet air-conditioning equipment for passenger cars, some of the gaskets being very similar in appearance to others. It is important that gaskets be applied where intended and only factory-cut gaskets should be used. Unless this is done, slow vacuum leaks which are difficult to locate, will develop and will lower the efficiency of the equipment.

To insure a complete supply of factory-cut gaskets at all times, so arranged that the maintenance man may quickly identify the gasket required, a board was made up, as shown in the illustration.

At the right-end of the board there is a key list, the contents of which are taken from the manufacturer's catalogue. This enables the maintenance man to refer to the list and find the proper gasket, or if he recognizes the gasket on the board he may note the hook number and refer to the list for proper identification for charging it out. By having the gaskets arranged as shown a low or depleted stock is quickly noted and additional gaskets ordered.

* * *



Hand-operated tongs as used for phos-copper brazing of coil terminals on a large d. c. generator—Where space permits, this process insures good connections—Melting temperature of phos-copper is 815 deg. C. (Photo courtesy of Westinghouse Electric & Mfg. Company)

* Simultaneously with the issuance of this proposed report in Docket proceeding No. 6651, an order is being issued in Docket proceeding No. 6593 providing that portions of this report dealing with the railroad radio service shall be deemed the Commission's proposed report in Docket 6593. Copies of that order and of this report are being served on all parties who appeared in Docket 6593.

(*Turn to second left-hand page*)

7 RIGID TESTS FOR CHILLED CAR WHEELS

The Code of Practice of the Association of Manufacturers of Chilled Car Wheels, ensures the railroads of a dependability of product so important where safety, economy and long life are basic factors of operation.

"The 7 Rigid Tests for Chilled Car Wheels" is just another "double check" to guarantee the maintenance of these superior quality standards of Chilled Car Wheels.

Test No. 5

The Thermal Test

The object of the Thermal Test is to demonstrate the ability of the wheel to withstand temperature stresses encountered in service due to brake application.

Method of making Thermal Test

THE 7 RIGID TESTS THAT GUARANTEE UNIFORMITY

1. Chill test block taken at least once in every ten wheels poured.
2. One complete chemical analysis with each heat.
3. Constant pyrometer checks for accurate processing temperature.
4. Drop test of finished wheel (A.A.R. Specifications).
5. Thermal test of finished wheel (A.A.R. Specifications).
6. Test for Rotundity.
7. Brinell Hardness test for maximum and minimum chill limits.

One of the great outstanding performances of the war has been the contribution of the Railroads of America.

3856

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

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Organized to achieve: Uniform specifications — Uniform inspection — Uniform product

NEW DEVICES

Lift Truck for Handling Car Wheels

An attachment for handling car wheels which fits the standard fork-type truck which is manufactured by the Baker Industrial Truck Division of the Baker-Raulang Company, Cleveland, Ohio, is now available. The attachment consists of a hinged hoe-like clamp which engages the top of the end wheel of a load on the

A lift truck equipped with a fork attachment and clamp for handling unmounted car wheels

truck fork. This clamp arm is raised to clear the wheels by a lever and may be latched in the raised position while the fork is run under wheels which are to be moved. The clamp is then lowered and the wheels are locked in position on the fork.

A truck of 6,000 lb. capacity will handle from one to six wheels on its 48-in. fork. When less than six wheels are to be carried, a pin stop on the clamp arm prevents them from tipping. Wheel diameters up to 36 in. can be carried. It is also possible to carry a capacity load of axles or two axles with wheels mounted on the truck fork without removing the clamp arm. An interchangeable boom attachment can be furnished for use in handling wheels into and out of gondola cars.

Train Protection Lights

Several lights for use by trains which have been derailed, stopped unexpectedly or for signaling to approaching trains have been developed by the Mars Signal-Light Co., Chicago. One of these lights, designated WR-5000, for use on high-speed passenger trains, produces a 500,000 candle power beam of white light which oscillates in the form of a horizontal figure eight and which can be changed to a red beam when necessary. The white light serves as a warning at grade crossings and the red one may be used by the engineer in the case of an emergency which may obstruct the opposite main track. The second headlight, available for locomotives other than high speed which do not require the white light, is made up with a red-beam projector only. A third lighting unit for protecting the rear end of trains produces a powerful red beam which does not oscillate.

The headlight for high-speed trains has two fixed outer reflectors and a movable 10-in. parabola reflector in which is mounted a 40-amp., 12-volt lamp. There are two such reflectors placed at an angle of 90 deg., one having a red lens for use as a distress or warning light. The reflectors are caused to oscillate by a 40-watt, 12-volt, 6,000 r.p.m. motor which is reduced to 8 r.p.m. on the oscillator shaft by a reduction gear. The control switch allows for bright, dim, and emergency red positions. There is also a push-button switch for inching the light to a fixed position such as for use on curves.

The headlight for use on freight or lower-speed trains employs a standard 250-watt, 32-volt locomotive headlight lamp in a 12-in. parabolic reflector. It produces a red oscillating beam of 350,000 candle power. The driving motor is rated 84 watts and 32 volts. The lights are furnished with pressed-steel cases for use on Diesel-electric locomotives and for steam locomotives a cast-aluminum case is used.

Protective Coating For Spray Booth Walls

Triad PR, a new protective coating for the sidewalls of both wet and dry spray booths, is announced by Detrex Corporation, Detroit 27, Mich. With this new coating between the walls and the layer of overspray that normally builds up, quick and easy cleanup is obtained. The booth so protected is stripped clean simply by spraying with water or steam; the Triad PR and accumulated paint flush off together. In dry booths which have no drainage facilities, the protective coating greatly facilitates scraping off the paint. The new protective coating can be applied by either brush or spray gun. It is said to give excellent coverage, and to dry to a hard, white, dustless coating which improves visibility in the booth.

Silicone Insulating Resins

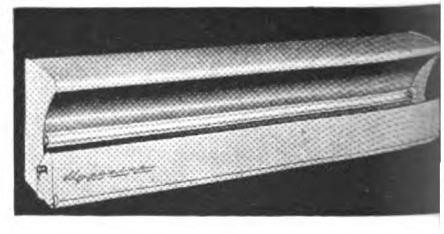
Silicones, a new class of organo-silicon insulating materials are now in commercial production by Dow Corning Corporation of Midland, Mich. These products have exceptional heat stability, resistance to moisture and freedom from carbonization at high operating temperatures. They are, therefore, natural complements to inorganic spacing insulation such as Fiberglas, asbestos and mica.

Several types of Dow Corning insulating resins have been under development, each designed for a specific use requirement. One of these resins, represented by Dow Corning 993 is employed as an impregnant and coating for Fiberglas served magnet wire and for woven Fiberglas electrical tapes, cloth and sleeving. It requires high temperatures to cure to a tack-free state; 1 to 3 hours at 250 deg. C. or shorter times at 350-400 deg. C. This combination provides flexible continuous insulating constructions which withstand long operating temperatures of 150 to 200 deg. C. in electrical equipment. A third type, represented by resin No. 2052, is intended as an impregnant and thermosetting dielectric for rotating parts of electrical equipment. On baking at 200 deg. C., it sets throughout its cross-section to a relatively hard resin which does not flow. It was designed primarily to be resistant to centrifugal displacement in parts of electrical equipment rotating at high speeds and at elevated temperatures.

Since these new organo-silicon resins permit operating temperatures at which paper, cotton and other organic insulations carbonize, they are not recommended for use with such materials. Because these insulating resins make possible higher safe operating temperatures, they permit the design of electrical equipment of increased power output, decreased size and weight and improved reliability. When electrical equipment of present design is insulated throughout with Silicone in conjunction with all inorganic spacing materials, a wider margin of safety from overload failures is obtained due to the heat stability and moisture proofness of the resins.

Germicidal Lamp

American Sterilizer Company, Erie, Pa. has recently placed on the market a new model of its Hygeaire germicidal lamp units for air disinfection. It differs from the original model in its shape and general appearance—the result of its having been



Streamline Hygeaire lamp

streamlined and made more attractive The unit employs a G-E germicidal lamp to project intensified ultraviolet rays across living or working areas above eye level A scientifically designed reflector provides both optimum intensity and diffusion of the rays that are lethal to air-borne bacteria The unit may be recessed into the wall, on wall or ceiling suspended. It is being offered to assist in combating absenteeism caused by cross-infection in offices and plants. Distribution is being made through The Graybar Electric Company and General Electric Supply Corporation.

(*Turn to next left-hand page*)

STILL FASTER TRANSPORTATION will be the Post-War Demand

To meet the post-war transportation problem of moving freight both more rapidly and more economically, modern equipment will be an absolute essential.

The most efficient type of motive power will be needed—steam locomotives that can haul heavy trains at high speeds on long runs.

Lima Super-Power 4-8-4s are built for just such work and have already thoroughly proved their capacity for maintaining exacting schedules in the handling of both freight and passenger traffic.

LIMA LOCOMOTIVE WORKS INCORPORATED

LIMA LOCOMOTIVE WORKS INCORPORATED, LIMA, OHIO

NEWS

No Mechanical Division Meeting in 1945

IN view of the present status of the war emergency and the request of the Office of Defense Transportation that all conventions not absolutely necessary to the war effort be deferred, it has been decided not to hold an annual meeting of the A. A. R. Mechanical Division or the Electrical Section of the Mechanical Division during the year 1945. Executive Vice-Chairman V. R. Hawthorne, in making this announcement, stresses the importance of no letup, but, in fact, increased attention to matters concerning safety and equipment maintenance. He says that arrangements will be made, as in the case of previous non-meeting years, to carry on the various activities of the Division relating to these and other important matters by means of correspondence supplemented by such group and committee meetings as may be necessary.

First Baldwin Road Diesel Tested on the B. & O.

A HIGH-SPEED Diesel-electric locomotive in the design of which knowledge gained from wartime railroad operations has been incorporated was on trial during the week ended January 20 on the Baltimore & Ohio between Baltimore, Md., and Washington, D. C. The locomotive, the first road type for through service built by the Baldwin Locomotive Works, in collaboration with the Westinghouse Electric & Manufacturing Company, has two 1,000-hp. eight-cylinder Diesel engines, mounted fore and aft. These engines and the electrical facilities are similar to those in Baldwin-Westinghouse switching and transfer locomotives now in extensive use. The underframe, trusses, and sides of the locomotive are welded together to form the equivalent of a single piece of rigid steel which it is expected will provide greater resistance to impact and a minimum of vibration. The cooling system for the engines is thermostatically controlled. Although designed primarily to pull freight trains at high speed, the locomotive handles passenger trains also and is said to perform equally well forward or backwards.

Special arrangements were made with the B. & O. to use its facilities for the test. Charles E. Brinley, chairman of the board of directors of the Baldwin Locomotive Works, rode in the cab of the locomotive on its first trip. It made three round trips daily during its trial.

A twin unit is now under construction. Coupled together, the two units can form a 4,000-hp. locomotive where high capacity is needed.

Diesel Locomotive Assignments Changed on Southern

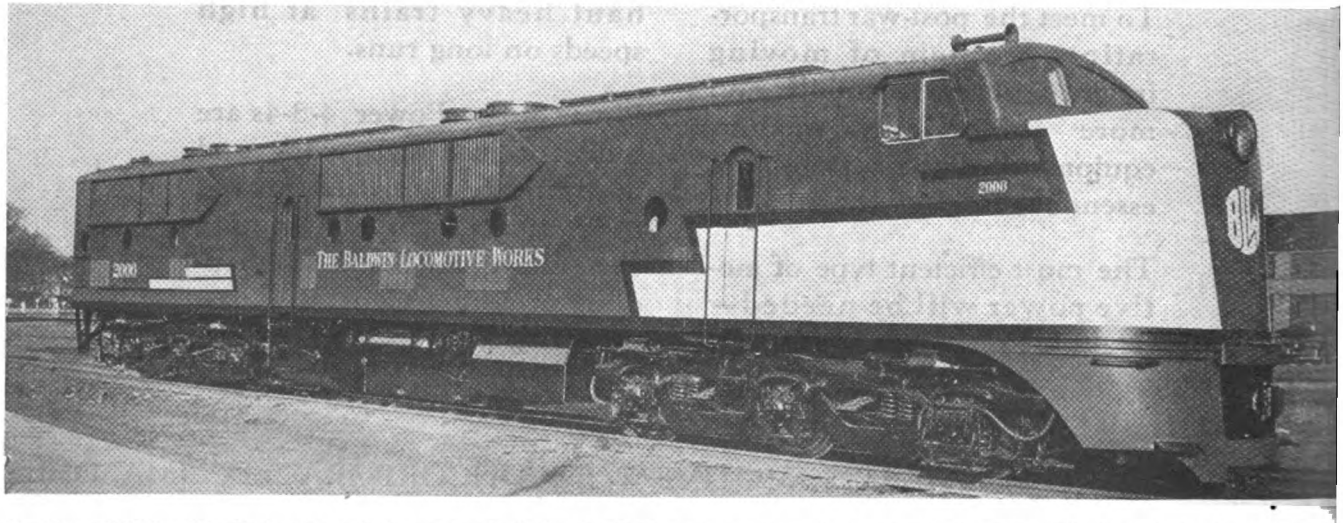
IN A story beginning on page 549 of the December, 1944, issue of the *Railway Mechanical Engineer* about Diesel locomotive repair facilities on the Southern, locomotive assignments were described which have since been changed. When the story was prepared Diesel locomotives were accumulating most of their between-shoppings mileage in relatively short shuttle runs. At the present time locomotives are dispatched from the shops at Chattanooga, Tenn., in either one of two services. One of these comprises a run from Chattanooga, Tenn., to Cincinnati, Ohio, to New Orleans, La., to Chattanooga, for a total mileage of approximately 1,700. The other service is between Chattanooga and Louisville, Ky., in which three round trips are made for a total mileage of approximately 1,900. This change in locomotive assignments has not altered the shop scheduling of repairs.

Steam Locomotive Study Launched by Railroad and Coal Companies

A NEW research project to improve the coal-burning locomotive has been launched jointly by six coal-originating railroads and three major coal producing companies. Plans were formulated at a meeting at the Biltmore Hotel, New York, on January 12, which was attended by the presidents of the six railroads; representatives of the coal companies; Karl Compton, president of the Massachusetts Institute of Technology, and Dean A. A. Potter of Purdue University. More than $1,000,000 has been subscribed to initiate research which will be handled by Bituminous Coal Research, Inc., as a distinct project with separate personnel and administered by the following locomotive development committees: R. B. White (chairman), president, Baltimore & Ohio; W. S. Franklin, vice-president, traffic, Pennsylvania; J. B. Hill, president, Louisville & Nashville; W. J. Jenks, president, Norfolk & Western; G. Metzman, president, New York Central; C. E. Newton, president, Chesapeake & Ohio; J. D. Francis, president, Island Creek Coal Company; G. M. Humphrey, president; M. A. Hanna; G. Stauffer, president, Sinclair Coal Company, and Dr. H. J. Rose, director of research, Bituminous Coal Research, Inc.

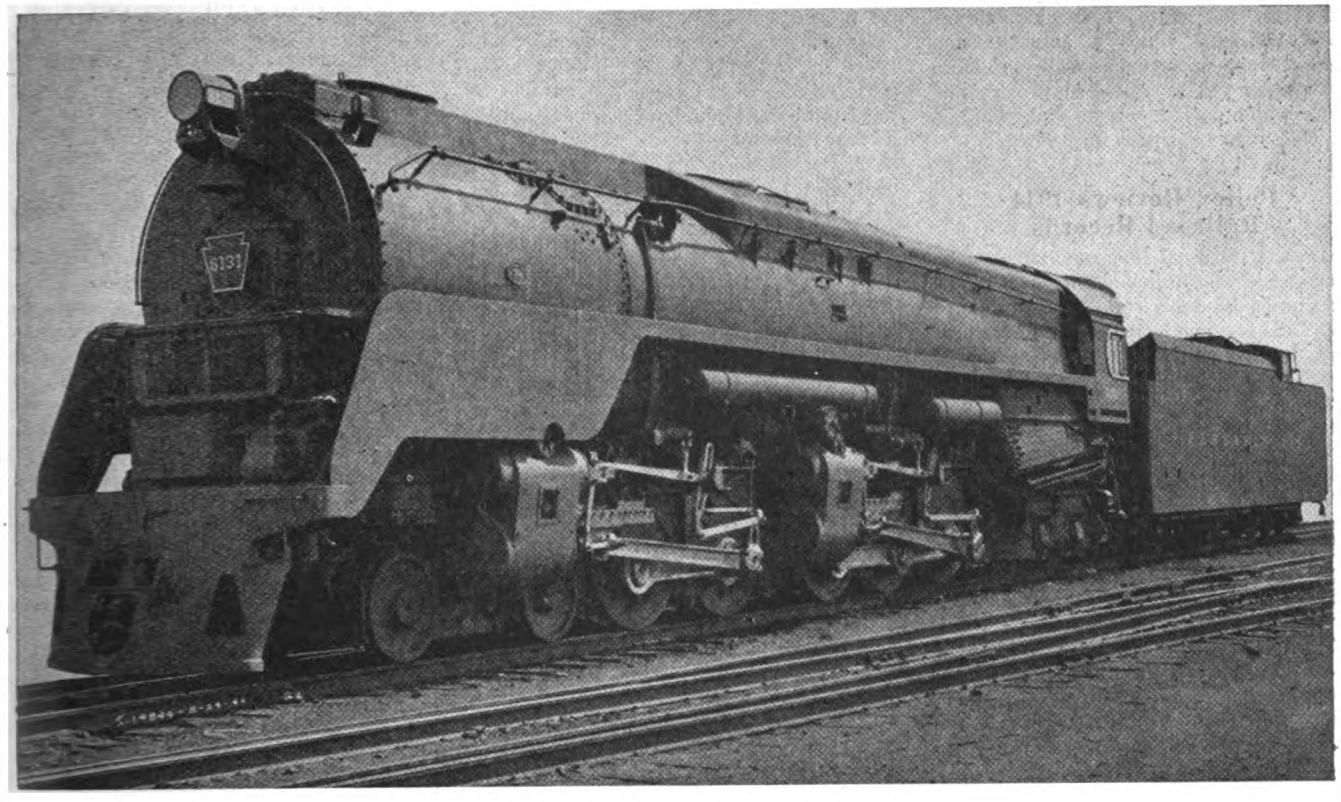
H. N. Eavenson, president of Bituminous Coal Research, in announcing the new project, said that although important recent improvements in coal-burning locomotives have been made by railroads and manufacturers and numerous other designs are known to be under active study, the existing developments will not be duplicated by this new project. The contributing companies were said to believe that the latest advance in science and en-

(Continued on next left-hand page)



The first 2,000-hp. Diesel-electric road locomotive built by the Baldwin Locomotive Works, in collaboration with the Westinghouse Electric & Manufacturing Company

Pennsylvania Railroad's ... New Fast Freight Engine



This Wartime Giant, P.R.R. Class Q-2, with its tender, built by the Pennsylvania Railroad, tips the scales at more than a million pounds. Overall length of the locomotive and tender is 124 feet 7 inches; its height is 16 feet 5 inches. The engine develops starting tractive effort (pull exerted on a standing train) of 114,860 pounds. High pulling power is maintained up to 70 miles an hour.

These Locomotives are equipped with the new TYPE E Locomotive Boosters.*

*Trade Mark Reg. U.S. Pat Off.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO

In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

gineering will permit other newer improvements to be made in the use of coal for railroad motive power, which may be revolutionary.

Mr. Eavenson pointed out that the U. S. Bureau of Mines statistics show that 98.9 per cent of the estimated natural fuel reserves of this country are in the form of coal—enough to last for more than 3,000 years. "It is therefore evident," he said, "that the railroads should continue to rely on coal which is abundant and cheap and which is commercially produced in 27 states. The continued growth and future stability of American railroads and the coal industry are inter-related."

Pelley Reviews 1944 Railroad Records

MAKING his usual year-end statement on December 29, J. J. Pelley, president of the Association of American Railroads, noted that "all previous transportation records were broken in 1944 by the railroads" when they handled, "without serious transportation difficulties," the "greatest volume of freight and passenger traffic in their history." Mr. Pelley's statement continued as follows:

"Freight traffic moved by the railroads in 1944 amounted to approximately 740 billion ton-miles. This was 1.8 per cent above that for 1943, the previous record, and two and one-fifth times the number of ton-miles moved in 1939.

"Railroads handled this enormous traffic load in the current year with virtually the same number of locomotives and with hardly more than a nominal increase in the number of freight cars compared with 1939. There also was only a slight increase in the number of passenger cars.

"Freight carloadings in 1944 totaled approximately 43,500,000 cars, or an increase of 2.5 per cent above the preceding year. The increase in the number of freight cars loaded and longer hauls per ton accounted for the increase in the ton-mile volume of freight.

"Passenger traffic in 1944, too, was by far the greatest for any year in railroad history. It amounted to 96 million passenger-miles. This was an increase of 9.3 per cent above 1943, and four and one-fifth times what it was in 1939. This unprecedented movement of passengers in 1944 resulted in part from Army troop movements, more than 10,700,000 men having been moved in special trains and special cars alone. This number does not include the millions of soldiers, sailors, and marines on furlough who traveled during the year, nor does it include small groups of individuals moving on order, nor Navy and Marine Corps movements, nor prisoners of war.

"Outstanding operating records established by railroads in 1944 follow:

"1. Average load of freight per train was 1,144 tons, the highest on record. In 1943 it was 1,116 tons.

"2. Performance per train more than doubled in 20 years, gross ton-miles per freight train hour having increased from 18,257 in 1924 to 37,548 in 1944, while net ton-miles per freight train hour increased from 8,222 in 1924 to 17,745 in 1944.

"3. Average daily movement of active freight cars was 52.8 miles in 1944 compared with 52 miles in 1943.

"4. Average haul of freight was 478 miles in 1944, compared with 469 miles in 1943.

"5. The average number of passengers per car and per train was much greater than ever before.

"6. Average revenue for hauling a ton of freight one mile was 0.942 cents compared with 1.116 cents twenty years ago.

"7. Average capacity of freight cars was 50.9 tons at the end of 1944, the highest on record.

"8. Tractive power of steam locomotives averaged 53,000 pounds, the highest ever recorded and an increase of 33 per cent compared with twenty years ago.

"There was a noticeable leveling off in traffic in the latter months of 1944 and present indications are that the record high mark in the volume of both freight and passenger traffic has been reached.

"From a financial standpoint, the results in 1944 have not been as satisfactory as in previous years. While gross revenues have continued to follow the line of increasing traffic, the peak in net earnings was reached in 1942 and has been declining since then. Gross revenues in the current year were more than two billion dollars higher than in 1942 but net railway operating income was off $340 million dollars. This has been due to higher wages and taxes and to increased cost of materials and supplies. Since the beginning of the present war, these costs, other than taxes, have increased by more than 25 per cent."

1945 Car Schedules Cut Sharply

A PREDICTION that freight-car production can be improved in 1945 over rates current in 1944, was made at a recent meeting of the Car Builders Industry Advisory Committee of the War Production Board, according to a W.P.B. announcement. This increase can be accomplished, industry spokesmen said, if the government claimant agencies and the railroads place orders properly spaced and far enough in advance to assure continuous production.

It was reported that present W.P.B. schedules call for the production of some 41,000 freight cars in 1945, a substantial decrease from the 1944 output. During the first eleven months of 1944 production averaged about 5,800 cars a month, although in three recent months, the average had dropped to about 5,300 cars per month. Over the 11-month period the monthly output was 4,600 cars from contract shops and 1,200 from railroad shops, but during the three months referred to the contract shops were averaging 3,800 cars and the railroad shops, 1,500.

This gain on the part of railroad shops, as compared to independent builders, was explained at W.P.B. as probably due to continuity of work at their shops. Under the quota system, it was pointed out, carriers' shops have produced about 16 per cent of total freight-car production during the past two years, as compared with a previous average estimated as 12 to 14 per cent of the total.

What was described as a new over-all policy setting a ceiling for future non-military production based on actual production in the fourth quarter of 1944 was outlined to the committee by W.P.B. executives. Even if there should be cutbacks in military requirements, non-military claimants would be allowed to absorb such released productive capacity only after a special survey of the manpower supply in affected labor areas. It is the purpose of the W.P.B. to make sure that skilled labor needed for war production will not be used for such non-military production, according to this explanation.

Present available estimates would allocate the expected 1945 freight-car production as follows: War Department 5,000; Navy Department, 600; Foreign Economic Administration, 3,000; Office of Civilian Requirements, 103; W.P.B. Steel Division, 239; leaving the remainder, or around 32,000 cars for the Office of Defense Transportation, through which railroad allocations are handled. The industry committee was told by Brig. Gen. Charles D. Young, O.D.T. deputy director, that third-quarter production may be concentrated on box cars. No prospect was developed in the committee meeting that authorizations for domestic railroad passenger car production in 1945 would go beyond a "very small number," because of the continued critical manpower situation

Orders and Inquiries for New Equipment Placed Since the Closing of the January Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Kentucky & Indiana Terminal	10	1,000-hp. Diesel-elec.	Baldwin Loco. Wks.

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Atchison, Topeka & Santa Fe	500[1]	50-ton box	Mt. Vernon Car Mfg. Co.
Baltimore & Ohio	500	50-ton auto-box	Greenville Steel Car. Co.
Bangor & Aroostook	100	40-ton box	Magor Car Co.
Chicago & Eastern Illinois	500	50-ton hopper	Pullman-Standard
Colorado & Wyoming	50	70-ton ballast	American Car & Fdry.
Great Northern	500	50-ton gondola	Pressed Steel Car
	250	70-ton flat	American Car & Fdry.
New York, New Haven & Hartford	500	Box	Pullman-Standard
Northern Pacific	500	Box	American Car & Fdry.
	500	Box	Pullman-Standard
Seaboard Air Line	500	50-ton box	Pullman-Standard
	300	50-ton flat	Bethlehem Steel Co.
Southern Pacific	500[1]	50-ton box	Mt. Vernon Car Mfg. Co.
Toledo, Peoria & Western	50	50-ton box	Pullman-Standard
Union Pacific	1,000[1]	50-ton box	Mt. Vernon Car Mfg. Co.
Western Maryland	100	50-ton box	General American Trans.

FREIGHT-CAR INQUIRIES

New York Central	1,000[2]	70-ton gondola	
St. Louis-Southwestern	25	70-ton covered hopper	

[1] For third-quarter delivery.
[2] For the Pittsburgh & Lake Erie.

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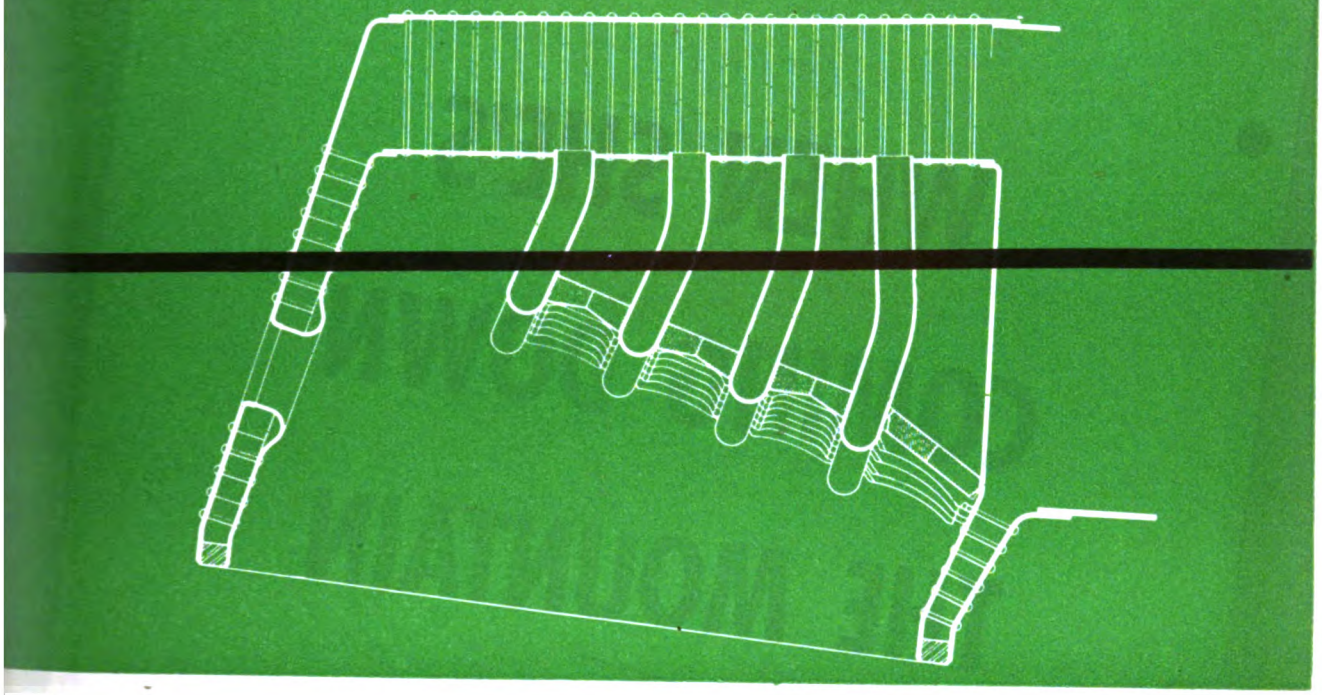
TO SAFEGUARD THE ENTIRE CROWN SHEET



THE installation of Security Circulators assures a positive flow of water over the crown sheet at all times. To give complete protection the Security Circulators should be adequate in number and suitably spaced from the flue sheet to the door sheet.

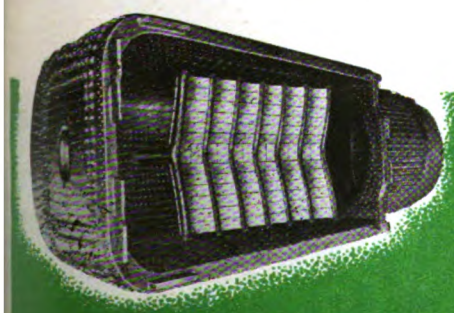
OTHER OUTSTANDING ADVANTAGES

Security Circulators are adaptable to any type of locomotive and to any size of firebox.

They increase the strength of the firebox structure and help to prevent boiler distortion.

They form an ideal support both for crown sheet and arch brick, and permit the use of a 100% arch in any type of firebox.

The installation of Security Circulators makes locomotives available for continuous operation over longer periods of time. Such locomotives have better combustion and longer arch life with less flue plugging and less cinder wear, so that a minimum of boiler maintenance is required.



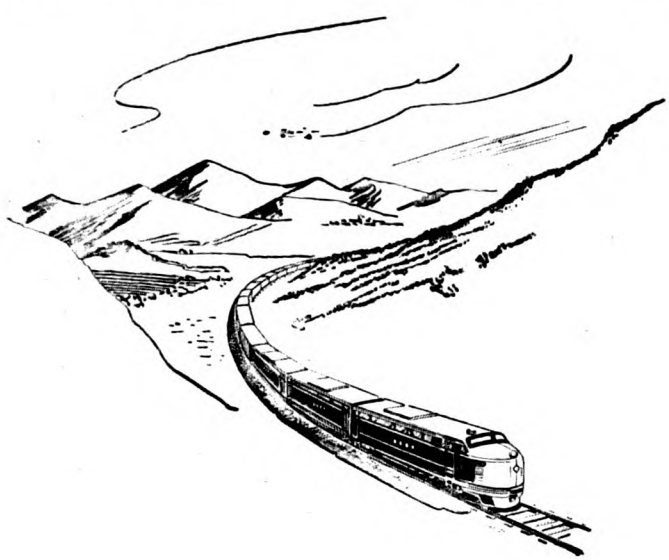
AMERICAN ARCH COMPANY, Inc.

NEW YORK • CHICAGO

SECURITY CIRCULATOR DIVISION

IT'S A GREAT NEW DAY FOR RAILROADING

WHEN SHE'S COMING DOWN THE MOUNTAIN



GENERAL MOTORS
LOCOMOTIVES

IT'S A GREAT NEW DAY FOR RAILROADING

—or rolling on the plain,

the electric retarding brake in
General Motors Diesel
freight locomotive
does an important job:

It enables heavy loads to take
steep grades safely and in faster time
without stops for cooling the wheels,
and few for setting retainers.

It saves much time in flat country
when making slowdowns;
the electric retarding brake can be
released quickly at any speed.

ON TO FINAL VICTORY ★ BUY MORE WAR BONDS

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION · LA GRANGE, ILL.

Supply Trade Notes

WORTHINGTON PUMP & MACHINERY CORPORATION.—*Clarence E. Searle* has been elected president of the Worthington Pump & Machinery Corporation to succeed *Harry C. Beaver,* who becomes vice-chairman of the board of directors and chairman of the management committee. Mr. Beaver had

Clarence E. Searle

been president of the corporation since 1931, and Mr. Searle had been vice-president in charge of sales since joining the Worthington organization in 1932, following a long period of service in various executive capacities with the Allis-Chalmers Manufacturing Company of Mil-

Hobart C. Ramsey

waukee, Wis. *Hobart C. Ramsey,* vice-president in charge of operations, has been elected executive vice-president; *Edwin J. Schwanhausser,* vice-president in charge of manufacturing and sales operations in Buffalo, N. Y., has been elected vice-president in charge of sales, and *Leslie C. Ricketts,* manager of the Harrison, N. J., works, has been elected a vice-president.

◆

GENERAL ELECTRIC COMPANY.—*David C. Prince,* vice-president of the General Electric Company, has been appointed in charge of the company's general engineering laboratory, the activities of which will be broadened to include the requirements of the entire company.

◆

AMERICAN BRAKE SHOE COMPANY.—*William T. Kelly, Jr.,* general purchasing agent for the American Brake Shoe Company, has been appointed executive vice-president of the company's Kellogg division. Mr. Kelly will continue also his duties as general purchasing agent.

◆

AMERICAN LOCOMOTIVE COMPANY.—*L. S. Peabody* has been appointed eastern district sales manager for steam and Diesel locomotives for the American Locomotive Company to succeed *A. K. Auburn,* who has resigned. Mr. Peabody also will retain all of his present duties as district sales man-

L. S. Peabody

ager of the company's Railway Steel-Spring Division. He began his career with the Western Electric Company where he remained for a few years and then transferred to the Burnet Company as a salesman of mill and electrical supplies for the railroad equipment field. He joined the sales force of the Railway Steel-Spring Company in 1909 and later was appointed New York district sales manager, which position he continued to occupy after the consolidation of the Railway Steel-Spring Company with the American Locomotive Company. Mr. Peabody subsequently was appointed district sales manager of that division.

◆

PITTSBURGH STEEL FOUNDRY CORPORATION.—*Thomas F. Dorsey,* sales manager of the Fort Pitt Steel Casting Company, has joined the Pittsburgh Steel Foundry Corporation, Glassport, Pa., in a special representative capacity.

Army-Navy "E" Awards

Leslie Company, Lyndhurst, N. J. Fourth renewal. The Maritime "M" has also been presented to the company.

FLANNERY BOLT COMPANY.—*W. S. Kirkpatrick* has been appointed assistant to the president of the Flannery Bolt Company, Bridgeville, Pa., with headquarters in New

W. S. Kirkpatrick

York. Mr. Kirkpatrick was formerly associated with the management firm of Houston & Jolles of New York and was vice-president of the A. O. G. Corporation of Providence, R. I. Previously he was contract officer for the British Purchasing Commission, following several years in Europe on special assignment for the International Telephone & Telegraph Corp.

◆

UNITED STATES RUBBER COMPANY.—*James E. Power* has been appointed eastern sales manager of the mechanical goods division, United States Rubber Company. Mr. Power began his rubber career in 1906 as an office boy. Five years later he

Pach Bros., N. Y.

James E. Power

became a salesman, and in 1926 he was appointed manager of the New York [illegible] of the mechanical goods division. [illegible] terrupted his career during World War I to join the United States Navy. He returned to his post in 1919, and later became assistant manager of branch [illegible]

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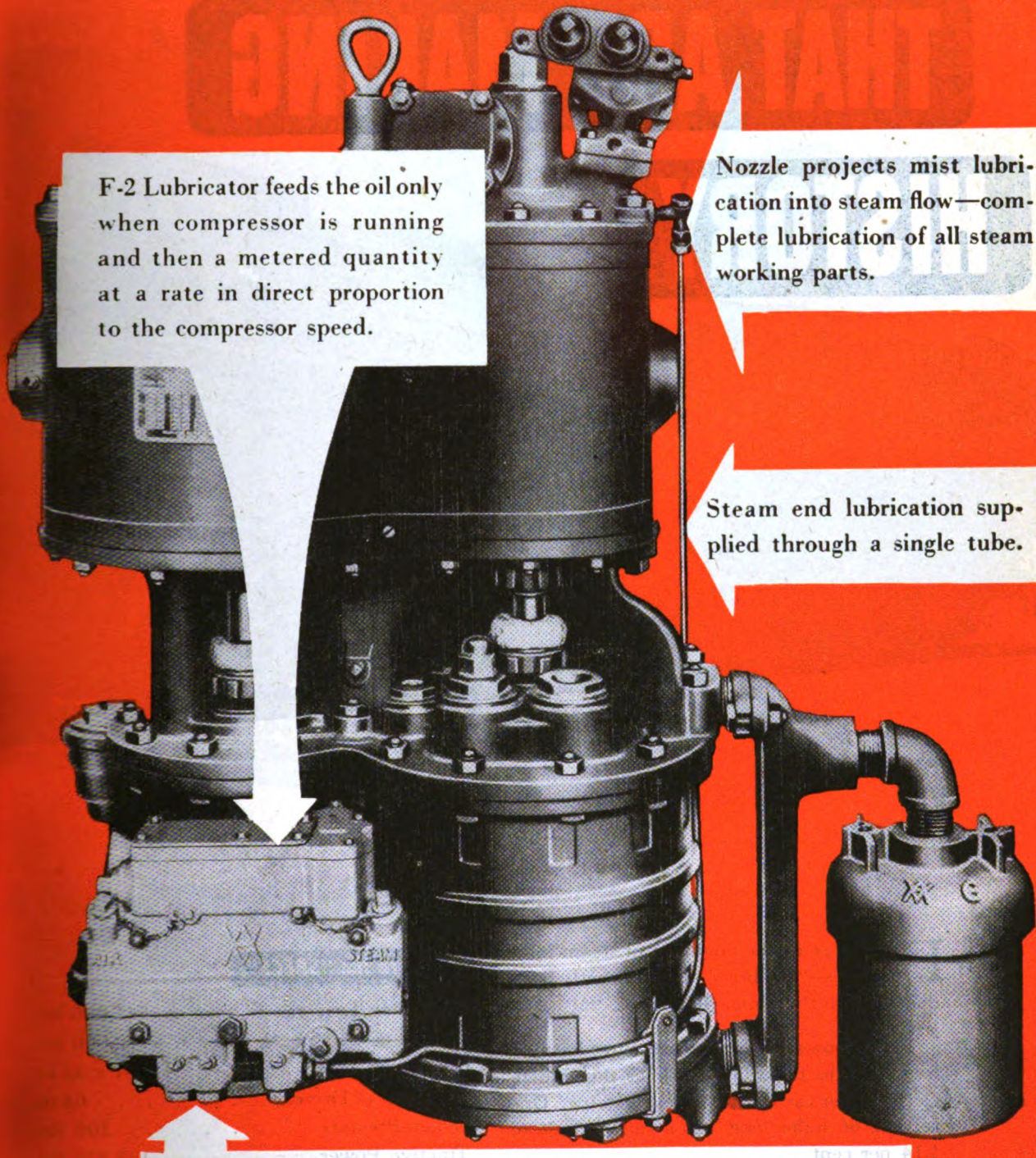
Controlled Compressor Lubrication *by* "F-2" Lubricator



F-2 Lubricator feeds the oil only when compressor is running and then a metered quantity at a rate in direct proportion to the compressor speed.

Nozzle projects mist lubrication into steam flow—complete lubrication of all steam working parts.

Steam end lubrication supplied through a single tube.

F-2 Lubricator Mounted on Pads on the Air Cylinders. Air cylinders lubricated through feed ports in mounting pads.

Westinghouse Air Brake Company

Wilmerding, Pa.

LOCOMOTIVES THAT ARE MAKING HISTORY

FIVE more of the mightiest of steam locomotives—"Big Boys"—have recently been delivered to the Union Pacific.

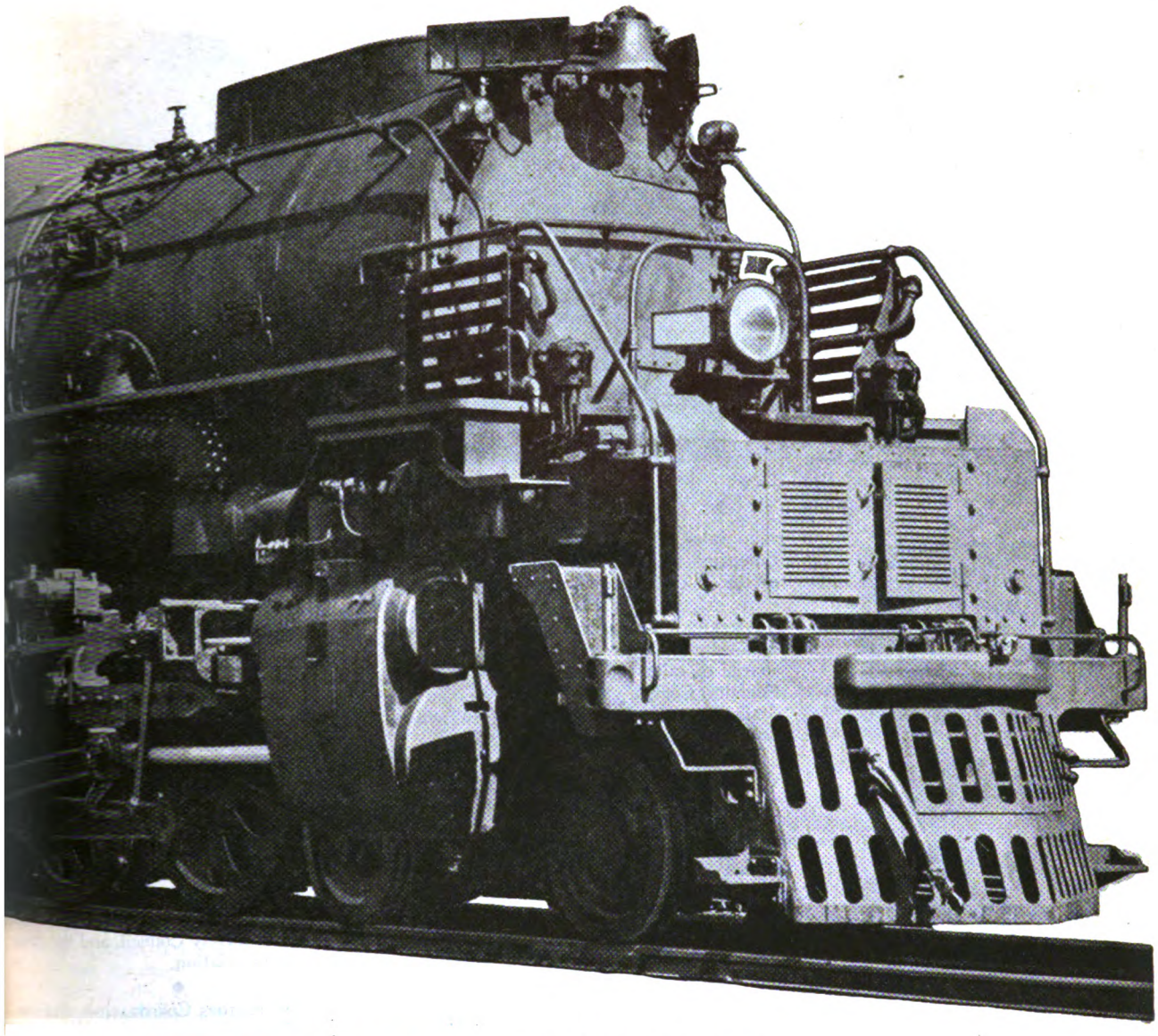
These powerful locomotives are hauling freight trains of 3,500 tons over the Ogden-Green River run daily, without a helper. One section, 66 miles long, has a ruling grade of 1.14 per cent.

American Locomotive has delivered 25 of these "Big Boys" to the Union Pacific. The first "Big Boy" was delivered in September 1941, just in time to take care of the heavy freight being shipped by rail through the Ogden-Green River district; 3,836,143,000 gross ton miles in 1941; 5,958,950,000 gross ton miles in 1943.

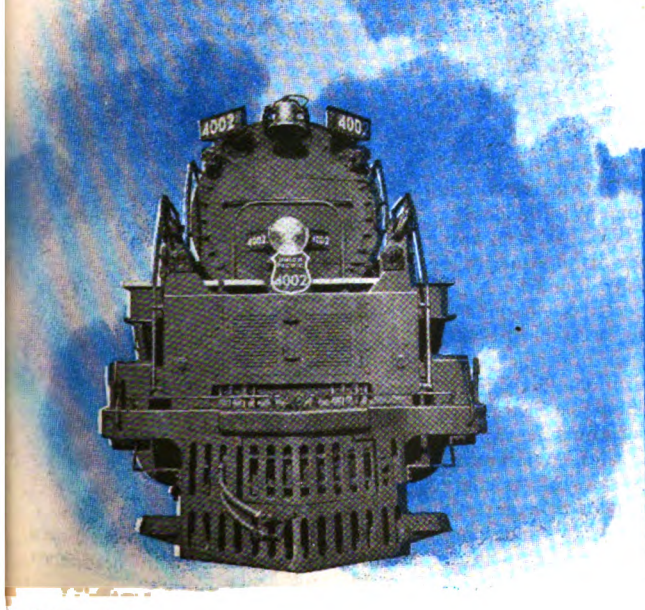
Here are the "SPECS":

Weight on Drivers	545,000 lbs.
Weight of Engine	772,000 lbs.
Cylinders	23¾ x 32 in.
Diameter of Drivers	68 in.
Boiler Pressure	300 lbs.
Tractive Power	135,375 lbs.
Tender Capacity—Water	25,000 gals.
Tender Capacity—Fuel	28 tons

Locomotive designs developed by American Locomotive Company have been, are, and will continue to be powerful factors in American railroad operating efficiency and economy.



● *Unsurpassed for the Job because Built for the Job*



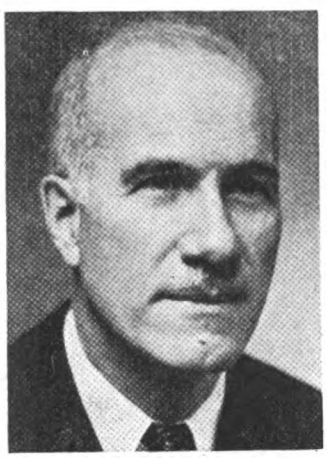
American Locomotive

NEW YORK

H. S. McPherson, in charge of mechanical goods sales in St. Louis since 1935, has been appointed midwestern sales manager

Pach Bros., N. Y.
W. M. Ballew

of the mechanical goods division, and *W. M. Ballew,* of Kansas City, Mo., has been shifted to the post of southwestern sales manager. Mr. Ballew will be responsible



Pach Bros., N. Y.
H. S. McPherson

for sales in branch offices in Kansas City, Tulsa, Denver, Houston, Dallas, New Orleans, Omaha and Minneapolis. Mr. McPherson's territory includes Detroit, Cincinnati, Indianapolis, Chicago, Milwaukee and St. Louis.

◆

T-Z Railway Equipment Company.—*L. R. Gurley* has been appointed vice-president of the T-Z Railway Equipment Company, Chicago. Mr. Gurley will, in addition to engineering and production responsibilities, be in charge of railway sales in the eastern and northeastern states. Mr. Gurley was born in Altoona, Pa., and is a graduate in railway mechanical engineering of the University of Pittsburgh, Pa. (1920). In January, 1923, he completed a three-year course as a special apprentice in the Altoona shops of the Pennsylvania and became a motive-power inspector assigned to the office of the superintendent of motive power at Pittsburgh. In May, 1924, he became associate editor of the Railway Age and *Railway Mechanical Engineer.* He left the Simmons-Boardman Publishing Corporation in 1929 to become editor of Welding, a publication of Steel Publications, Inc. In 1935 he rejoined the Simmons-Boardman publications as a business department representative at Chicago and in 1940 was transferred to the eastern territory, working out of the New York office. He resigned in February, 1944, to join the Chi-

L. R. Gurley

cago sales staff of the Haire Publishing Company, and now becomes vice-president of the T-Z Railway Equipment Company.

◆

American Car and Foundry Company.—*R. A. Williams* has been appointed in charge of sales for the American Car and Foundry Company to succeed William L. Stancliffe, whose retirement from active

R. A. Williams

service was reported in the January issue. *George W. Mitsch* assistant manager of foundries at the Madison, Wis., and St. Louis, Mo., plants since 1935, has been appointed operating manager of all American Car and Foundry Company foundries.

R. A. Williams was elected a vice-president of the company in December, 1943, and had been Mr. Stancliffe's chief assistant in the sales organization. He joined the engineering department at the St. Louis, Mo., plant in 1924 and subsequently served in varying capacities as sales engineer at several of the company's sales offices and more recently as district sales manager at the Cleveland, Ohio, and Washington, D. C., offices.

George W. Mitsch joined the American Car and Foundry Company's St. Louis foundry in 1913 as a patternmaker apprentice. He subsequently was appointed draftsman at that plant, and, later, engineer of

George W. Mitsch

foundries. Mr. Mitsch served twice as president of the St. Louis Foundrymen's Club and affiliated this organization with the American Foundrymen's Association, with which he has continued his activity. He also has been connected with the Association of Manufacturers of Chilled Car Wheels, having assisted in the preparation of the first specification and operating standards, and the institution of the inspection service covering the production of chilled car wheels. He has been active in railway car wheel design and testing, both for the American Car and Foundry Company and the association, and in 1940 was appointed a member of the president's advisory committee to formulate plans for wheel improvements. On completion of this work he was appointed a member of the design committee. Mr. Mitsch is a member of the Car Department Association of St. Louis, the St. Louis Safety Council, and the Army Ordnance Association.

◆

General Motors Corporation, Electro-Motive Division.—*Kenneth Auburn* and *Milton LaRiviere* have been appointed to the sales staff of the eastern sales office

Kenneth Auburn

of the Electro-Motive Division, General Motors Corporation, with headquarters

at New York. Mr. Auburn will assist *Paul R. Turner,* eastern regional manager, with northeastern regional sales, and Mr. LaRiviere will assist in the southeastern region. Mr. Auburn was formerly New

Milton LaRiviere

York district sales manager of the American Locomotive Company, with which company he had been employed for the past 20 years. Previously to his appointment as district sales manager he had served in the engineering and shop departments. He is a member of the New York Railroad Club, the New England Railroad Club, and the Central Railway Club of Buffalo. Mr. LaRiviere was previously with the Atlantic Coast Line for about 15 years following a period of employment in the Boston, Mass., office of the Canadian National. He received his education at the Boston University, the School of Business Administration, and at the Harvard University's Extension Institute on Transportation.

◆

EASTERN RAILWAY SUPPLIES, INC.—*George M. Cooper,* southwestern representative of the Southern Wheel and Brake Shoe & Castings divisions of the American Brake Shoe Company, has been appointed

George M. Cooper

sales manager of Eastern Railway Supplies, Inc., New York, to succeed *W. E. Bugbee,* who has resigned to become a manufacturers' representative for railway equipment and supplies in the Southwest, with headquarters at San Antonio, Tex. *James F. Hartley,* formerly in charge of the Cleveland, Ohio, territory for the Buda Company, has been appointed sales and service engineer of Eastern Railway Supplies, with headquarters at New York.

George M. Cooper received his education at the Drake Business school and Sales Analysis Institute, and then entered the employ of the Ramapo Iron Works, which later became the Ramapo Ajax Division of the American Brake Shoe Company, serving with this company in various capacities for 26 years. During most of this period he served as eastern representative, with headquarters at New York, but in July, 1942, he was transferred to Houston, Tex., as southwestern representative of the Southern Wheel and Brake Shoe & Castings divisions of the American Brake Shoe Company. He resigned in September, 1944, to become sales manager of Eastern Railway Supplies, with headquarters at New York.

◆

AIRCRAFT ACCESSORIES CORPORATION; AIREON MANUFACTURING CORPORATION.—The Aircraft Accessories Corporation, Kansas City, Kan., has changed its name to the Aireon Manufacturing Corporation. The name "Aireon" is intended to convey the thought that the products being manufactured are partly in the mechanical field as applied to aircraft and partly in the use of electronics as applied to various fields

Samuel W. Fordyce III

including train communication on railroads.

Samuel W. Fordyce III, assistant to the president of the Kansas City Southern, has been appointed general manager of the railway equipment division of the Aireon Manufacturing Corporation. In his new position, Mr. Fordyce will direct the introduction of the radio communications equipment for railroads as developed by Aireon and later market additional electronic and hydraulic equipment for use by railroads which the company expects to manufacture. Mr. Fordyce is a graduate of Harvard University and the Harvard Engineering School. He began his business career as an engineer for the Arkansas Power & Light Co., later becoming assistant general manager of the Mississippi Power & Light Co. He subsequently was employed for a number of years in banking and insurance in St. Louis, Mo., and began his railroad career in 1936 as industrial commissioner of the Louisiana & Arkansas. Shortly after the acquisition of this railroad by the Kansas City Southern Lines in 1938, he was appointed assistant to the executive vice-president and, in 1941, assistant to the president. During 1942, on a year's leave from the Kansas City Southern, he also served as assistant director in the Office of Defense Transportation in Washington.

◆

EUTECTIC WELDING ALLOYS COMPANY.—*C. F. Patterson and John A. Owen* have joined the field engineering staff of the Eutectic Welding Alloys Company, New York. Mr. Patterson will serve Eutectic customers in Michigan; Mr. Owen, in the state of North Carolina.

Obituary

JAMES D. CARTIN, general manager of the New York Air Brake Company's plant at Watertown, N. Y., died December 16.

◆

CHARLES S. TROTT, assistant treasurer and sales manager of the Parker-Kalon Corporation, died December 19. Mr. Trott was 45 years of age.

◆

FRANK B. ARCHIBALD, vice-president of the National Lock Washer Company at Newark, N. J., died at a hospital in New Rochelle on December 19.

◆

CHARLES E. BROWN, executive vice-president of The Okonite Company and vice-president of the Okonite-Callender Cable Company, Inc., died in Chicago on January 13. Mr. Brown was born in Philadelphia, Pa., on July 15, 1866, and at the age of 18 entered the employ of Marshall Field & Co., Chicago. Five years later he resigned to become vice-president of the Central Electric Company, Chicago. In 1925 he

Charles E. Brown

was elected executive vice-president and a director of The Okonite Company, of which he had been a director from 1919 to 1925. In 1925 he was also elected vice-president and a director of the Okonite-Callender Cable Company, Inc.

◆

WILLIAM L. BLISS, inventor of axle systems of railroad passenger-car lighting, died December 5. Mr. Bliss was 73 years of age. He was a graduate, with a degree in mechanical engineering, of Cornell University

(*Continued on second left-hand page*)

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in 1893. He was an electrician for the Riker Electric Motor Company of Brooklyn, N. Y., and an electrical engineer for the Consolidated Gas Company of New York before founding his own company, the Bliss Electrical Car Lighting Company in 1900. When the company was merged with several others to form the United States Lighting & Heating Co., Mr. Bliss was appointed chief engineer of the new firm and of the U. S. L. Battery Corporation. He retired in 1941 but continued to act as consulting engineer to the last-named firm.

A. P. STEINER, formerly chief engineer and superintendent of the Landis Tool Company, Waynesboro, Pa., died on January 8. Mr. Steiner had been with the Landis Tool Company since 1899 and during the past few years had acted in the capacity of consulting engineer.

Personal Mention

General

R. J. SNYDER, general foreman, car department of the Wheeling & Lake Erie at Brewster, Ohio, has been appointed assistant superintendent, motive power and cars, with headquarters at Brewster.

S. O. RENTSCHLER, mechanical superintendent of the Missouri Pacific, has been appointed assistant chief mechanical officer, with headquarters as before at St. Louis, Mo.

JOHN WESLEY HAWTHORNE, assistant superintendent of motive power of the Central of Georgia with headquarters at Savannah, Ga., has been appointed superintendent of motive power as noted in the January issue. Mr. Hawthorne was born on March 29, 1911, at Williamsport, Pa., and is a graduate of Purdue University (1933) with a B.S.M.E. degree. He then

John Wesley Hawthorne

worked at the Watertown, N. Y., plant of the New York Air Brake Company from July, 1933, until July, 1936, when he was transferred to Cleveland, Ohio, as a service representative. In 1940 he was granted a six months' leave from January through June to become acting air-brake instructor of the Chesapeake & Ohio at Richmond, Va., returning to the New York Air Brake Company at Cleveland as service representative. Mr. Hawthorne entered the service of the Central of Georgia on November 1, 1943, as assistant superintendent of motive power at Savannah.

J. O. HILL, assistant superintendent, motive power and cars of the Wheeling & Lake Erie at Brewster, Ohio, has been appointed superintendent, motive power and cars with headquarters at Brewster.

W. C. MARSHALL, assistant superintendent of motive power of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis., has been appointed assistant superintendent of motive power in charge of Diesel operation, with headquarters at Milwaukee.

G. E. DURHAM, superintendent, motive power and cars of the Wheeling & Lake Erie at Brewster, Ohio, has been appointed assistant vice-president, reporting to the executive vice-president and general manager, with headquarters at Cleveland, Ohio.

J. L. BROSSARD, division master mechanic, of the Chicago, Milwaukee, St. Paul & Pacific, at Chicago, has been appointed assistant superintendent of motive power, with headquarters at Milwaukee, Wis.

C. L. DICKERT, superintendent of motive power of the Central of Georgia at Savannah, Ga., has retired as noted in the January issue. Mr. Dickert was born in Newberry County, S. C., on October 12, 1873, and entered railroad service in 1890 as a machinist apprentice of the Richmond & Danville at Atlanta, Ga. After the Richmond & Danville merged with the Southern in 1896 he was transferred to the Southern shops in Atlanta as a machinist, later serving with the Atlanta, Knoxville & Northern (now part of the Louisville & Nashville) at Blue Ridge, Ga., from 1898 to 1899. He then became a locomotive fireman on the Central of Georgia. Some months later he returned to mechanical

C. L. Dickert

service as a machinist in the Columbus shops, and after working in the Savannah and Macon (Ga.) shops, became erecting-shop foreman, machine shop foreman, shop superintendent and master mechanic at Macon. On July 16, 1923, he was appointed superintendent of motive power.

E. G. JONES, general foreman of the Atlantic Coast Line at Tampa, Fla., has been appointed superintendent of motive power of the Charleston & Western Carolina with headquarters at Augusta, Ga.

M. W. MCMAHON has been appointed locomotive appliances inspector of the New York Central System with headquarters at New York.

PAUL VICTOR GARIN, who has been appointed engineer of tests of the Southern Pacific at San Francisco, Calif., as noted in the December issue, was born on February 28, 1914, at San Francisco. He is a graduate of the University of California

P. V. Garin

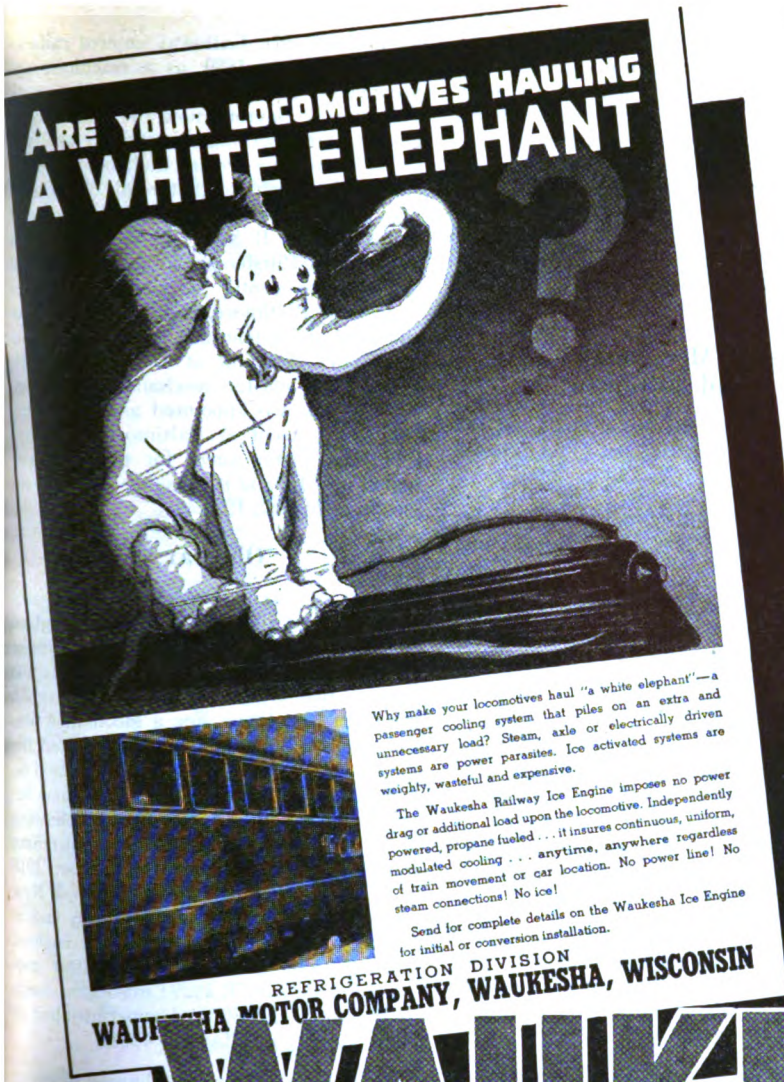
College of Engineering (1935). He entered the employ of the Southern Pacific on December 1, 1935, as a junior draftsman. He became dynamometer car assistant in March, 1936; draftsman, in May, 1936; inspector, new equipment, in November 1941; lubrication engineer, in September 1942; assistant engineer of tests in April 1943, and engineer of tests in August, 1944.

A. G. HOPPE, assistant to the mechanical assistant, chief operating officer, of the Chicago, Milwaukee, St. Paul & Pacific has been named assistant chief mechanical officer, with headquarters as before at Milwaukee, Wis. This is a change of title

E. W. PEWESTORFF, road foreman of engines of the Chicago & North Western at Chicago, has been appointed supervisor of motor-car equipment with headquarters at Chicago.

H. L. FERGUSON, road foreman of engines of the Union Pacific, has been appointed general mechanical inspector, with headquarters at Cheyenne, Wyo.

(*Turn to next left-hand page*)



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LARGEST BUILDERS OF MOBILE ENGINE-DRIVEN REFRIGERATION AND GENERATOR EQUIPMENT

WILLIAM H. C. CHAPMAN, assistant electrical engineer of the Chicago & North Western at Chicago, has been appointed electrical engineer, with headquarters at

William H. C. Chapman

Chicago. Mr. Chapman was born at Leyland, England, on August 26, 1886. He received his higher education at the Salford Royal Technical School, Salford, England, and held a number of positions in England after graduation. In 1910 he came to the United States and accepted a position with the Commonwealth Edison Company, Chicago, and later was in the employ of the Chicago Bell Telephone Company. Mr. Chapman in 1911 became an electrician in the service of the North Western at Chicago, and three years later was appointed chief electrician with headquarters at Clinton, Iowa. In 1916 he became electrical inspector, with headquarters at Chicago, and in 1927, assistant electrical engineer.

J. A. ANDREUCETTI, electrical engineer of the Chicago & North Western, at Chicago, has been appointed chief electrical engineer, with headquarters at Chicago. Mr. Andreucetti was born at Chicago on May 1, 1881, and entered railway service in 1901

J. A. Andreucetti

in the operating department of the Illinois Central. In 1905 he went with the North Western as an electrical helper at Chicago, subsequently serving as electrician, acting foreman on electrical construction, foreman on electrical construction and general foreman. In September, 1916, Mr. Andreucetti was appointed assistant electrical engineer, and in May, 1927, electrical engineer. Mr. Andreucetti is a past president of the Railway Electrical Engineers, and present retary-treasurer of the Association of Railway Electrical Engineers, and a former secretary of the Electrical section, Mechanical division, A. A. R.

M. P. HANNON has been appointed mechanical inspector of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis.

Master Mechanics and Road Foremen

S. H. KAHLER, master mechanic of the Toledo Terminal at Toledo, Ohio, has resigned.

L. L. ROBINSON, JR., has been appointed master mechanic of the Baltimore & Ohio, with headquarters at Glenwood, Pa.

O. J. ROBINSON, district foreman of the Nebraska division of the Union Pacific at Council Bluffs, Iowa, has been appointed assistant master mechanic, with headquarters at Council Bluffs.

R. C. HEMPSTEAD, assistant superintendent of motive power of the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis., is being relieved of that position at his own request and has been appointed division master mechanic, with headquarters at La Crosse, Wis.

H. C. DUGAN has been appointed master mechanic of the Toledo Terminal at Toledo, Ohio. Mr. Dugan was formerly general foreman of the New York, Chicago & St. Louis at Conneaut, Ohio.

H. L. CRANE, assistant master mechanic of the Union Pacific at Pocatello, Idaho, has been appointed master mechanic, with headquarters at Spokane, Wash.

RALPH LOGEMAN, general enginehouse foreman of the Chicago Great Western at Oelwein, Iowa, has been promoted to master mechanic, with the same headquarters.

P. C. BRANCH, general foreman of the Southern at Birmingham, Ala., has been appointed master mechanic, with headquarters at Ludlow, Ky.

Car Department

W. C. HUNT has been appointed assistant supervisor car repairs, Eastern district, of the Erie, with headquarters at Cleveland, Ohio.

F. J. LARRISSEY, chief A. A. R. inspector of the Erie at Cleveland, Ohio, has been appointed chief shop inspector, with headquarters at Cleveland.

A. V. NYSTROM, general car foreman of the Chicago, Milwaukee, St. Paul & Pacific at Kansas City, Mo., has been appointed assistant to the superintendent of the car department, with headquarters at Milwaukee, Wis.

Purchasing and Stores

WALTER S. GALLOWAY, purchasing agent of the Baltimore & Ohio at Baltimore, Md., has retired. Mr. Galloway entered railway service in June, 1889, as a machinist apprentice in the employ of the Cincinnati, Hamilton & Dayton (now the Baltimore & Ohio). After serving successively as claim clerk, locomotive fireman and rodman in the engineering corps of that road, Mr. Galloway in February, 1900, became inspector of material of the B. & O. He became resident inspector at Pittsburgh, Pa., thereafter, and served subsequently as assistant engineer of tests at Baltimore, enginehouse foreman and general foreman at Cumberland, assistant master mechanic at Mt. Clare (Baltimore), and master mechanic at Grafton, W. Va. He was appointed assistant to the purchasing agent at Baltimore in March, 1905; purchasing agent for the Allegheny region in 1918, and purchasing agent for the system in March, 1920.

Obituary

HUGH RONALDS, superintendent of motive power of the Lehigh & New England at Pen Argyl, Pa., died there on December 20. Mr. Ronalds was 56 years old. He was born at Brooklyn, N. Y., on February 22, 1888. In 1906 he became a locomotive fireman on the Long Island. He entered the employ of the Lehigh & New England as a fireman on November 18, 1913, and became a locomotive engineer the following May. After serving with the merchant marine as a marine engineer from 1918 to 1922, he returned to the Lehigh & New England as a locomotive engineer, and in March, 1923, became foreman of engines. He was appointed assistant master mechanic on January 1, 1929; master mechanic on February 1, 1930, and superintendent of motive power on May 20, 1931.

T. M. KIRKBY, chief mechanical officer of the Green Bay & Western, with headquarters at Green Bay, Wis., died while on a hunting trip near Crandon, Wis., on November 26. Mr. Kirkby was born at Oslo, Norway, on July 4, 1886, and was a graduate of the University of Norway, Oslo. He entered railway service in 1905 as a mechanical draftsman in the employ of the Chicago, Milwaukee, St. Paul & Pacific, subsequently serving as a mechanical draftsman on the Duluth & Iron Range (now the Duluth, Missabe & Iron Range), from 1911 to 1916. In the latter year he returned to the Milwaukee as a mechanical draftsman; two years later became chief draftsman, mechanical department, at Chicago, and in 1922 mechanical assistant to the general superintendent. In 1926 Mr. Kirkby went with the Missouri-Kansas-Texas as mechanical engineer with headquarters at Parsons, Kan. On April 1, 1936, he became mechanical representative of the G. B. & W.; five months later, superintendent of motive power and equipment at Green Bay, and one February 1, 1944, chief mechanical officer.

JOHN FLETCHER, general inspector of the Seaboard Air Line at Norfolk, Va., died there on November 22. Mr. Fletcher was 59 years old.

A. P. PRENDERGAST, who retired as mechanical superintendent of the Texas & Pacific at Dallas, Tex., in 1934, died on October 17 at Cameron, W. Va.

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Railway Mechanical Engineer

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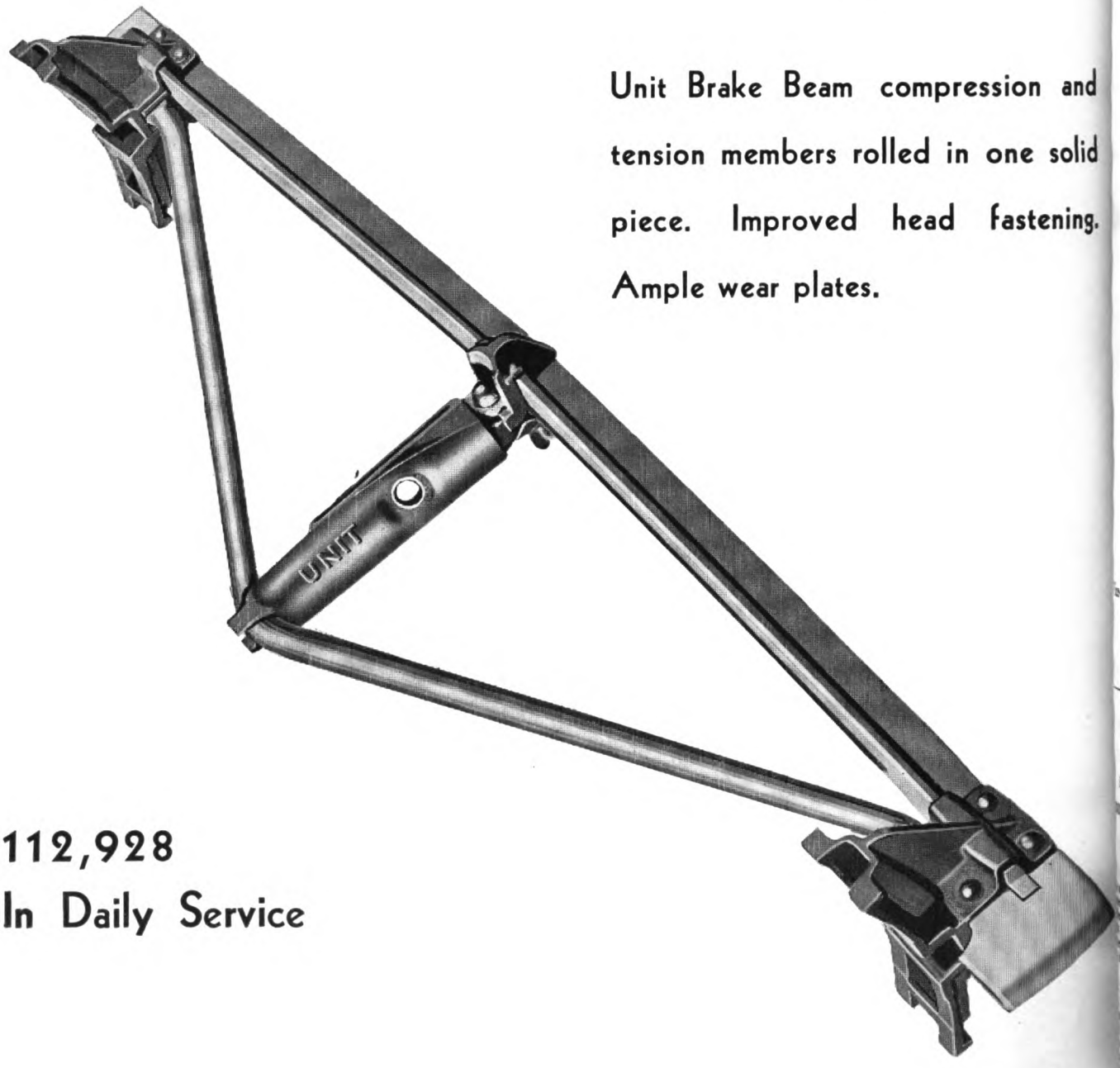

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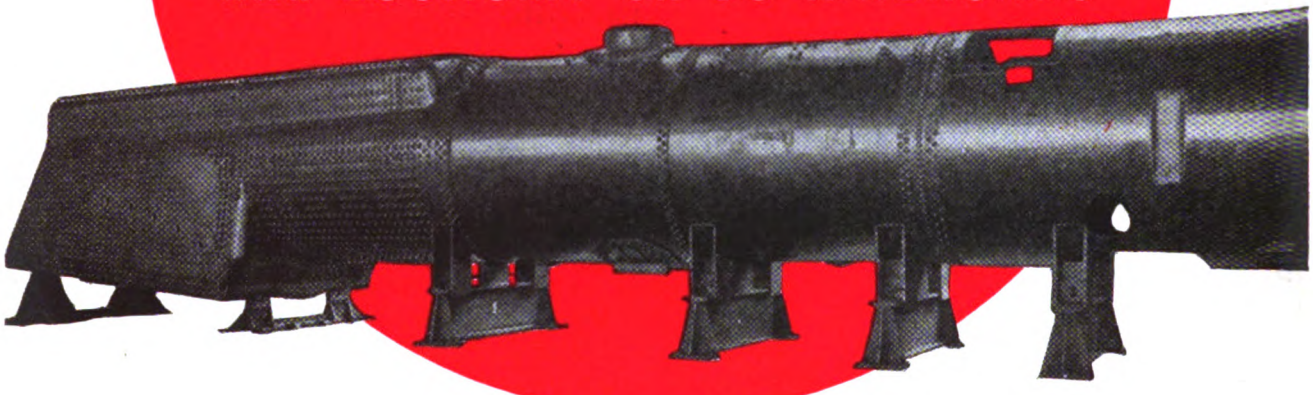

This locomotive boiler, equipped with staybolts made from Byers Staybolt Iron, is something you might see in the shops of any of 75 railroads that have used the material. And each installation has meant protection of locomotive availability, and a substantial saving in dollars and cents.

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Geared Turbine Locomotive

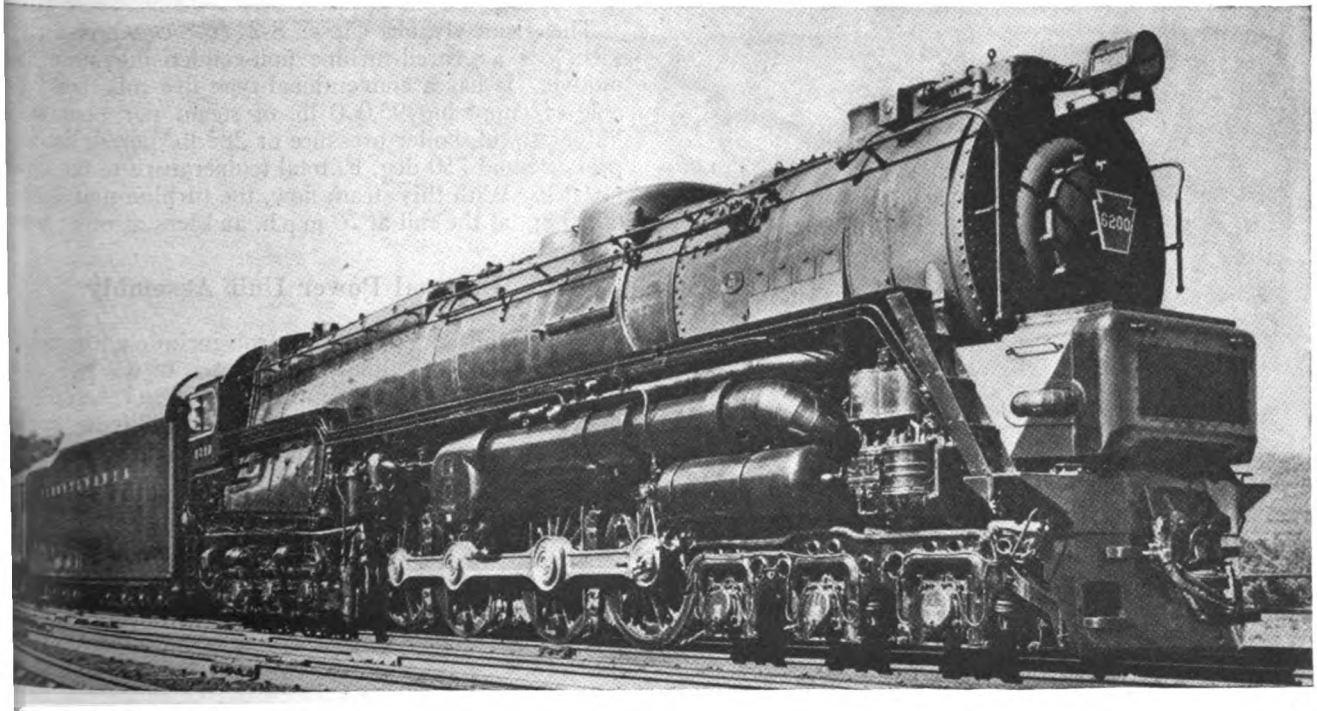
By J. S. Newton*
and
W. A. Brecht†

The forward turbine develops 6,900 shaft horsepower and drives through double reduction gears to quill gears on two axles—One-lever control

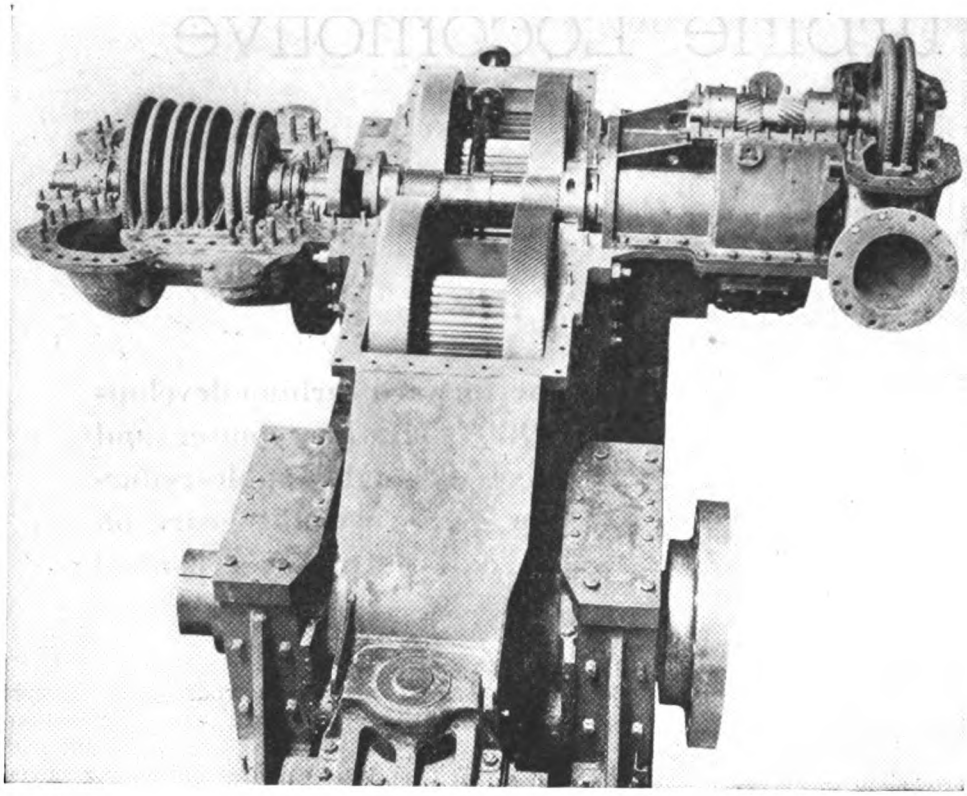
THE pioneer direct-driven steam-turbine locomotive, now on main-line trials by the Pennsylvania for long-distance high-speed passenger and freight service, offers several inherent advantages to the industry. Compared to the two cyclinder reciprocating locomotive, the geared turbine drive provides: 20 per cent more power from a given boiler; smaller driving wheels and lower center of gravity; uniform torque without reciprocating parts, dynamic augment, and unbalanced forces. The power unit making possible these advantages for the first direct-connected steam-turbine locomotive in this country is the result of new and significant engineering advances. For example: (1) the power unit is a completely self-contained assembly; (2) a three-point support avoids transmitting frame distortion to the gear case; (3) a single small lever controls both speed and direction of the locomotive; (4) hardened and ground double helical gearing is used commercially for the first time; and (5) tooth loading of the high-speed pinion is practically double that ordinarily used.

The reciprocating steam locomotive with Stephenson valve gear was introduced over a hundred years ago. Although it has been vastly improved in detail, its essential elements—fire-tube boiler, cylinders, valve mechanism, and linkages, and driving rods—have suffered no fundamental change. Not that many innovations have not been tried. Locomotives have been built with water-tube boilers, compound engines and poppet valves. While some of them have been successful (and have been adopted), those that departed radically from the simple steam engine have not been adopted, either because they did not prove economical or because of mechanical inadequacy.

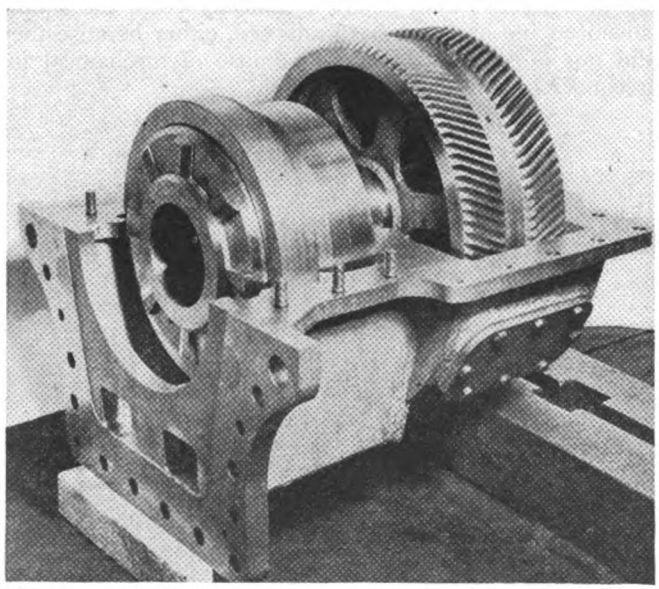
* Assistant engineer manager, Steam Division, Westinghouse Electric & Manufacturing Company, South Philadelphia, Pa.
† Manager, Transportation Engineering, Transportation and Generator Division, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.



In 1937, the Pennsylvania became interested in the possibility of improving the performance of its standard passenger locomotive by replacing the single expansion reciprocating engines with a geared turbine. After two years of study, Westinghouse and Pennsylvania engineers were convinced that the performance could be greatly improved, and that a good mechanical design would result. However, the cost of making modifications to existing locomotives would be almost as much as the cost of a complete new engine. Therefore, a larger, new high speed locomotive was studied. Engineers of the Pennsylvania-Baldwin Locomotive Works, and Westinghouse completed the designs and late in 1941 proceeded with the construction of a 6,900 shaft horsepower locomotive for high-speed freight or passenge service. This rating was considered the greatest prac ticable for a rigid frame four driving-axle unit. Som material was on hand before our entry in the war, bu construction was stopped and the design changed to util ize non-critical materials. This required a change i wheel arrangement from the 4-8-4 to the 6-8-6 type Manufacture on a limited scale was again started in th second quarter of 1943, and the locomotive delivered the Baldwin Locomotive Works to the Pennsylvania September, 1944.



The transmission unit with the turbines in place — The contact surfaces of the hardened and ground double helical gearing are 450 Brinnell—The spur gears between the helical gears mesh with the axle gear



The slow-speed reversing gear and clutch mounted in the lower half of the overhung gear housing

Geared-Turbine Drive

The Pennsylvania Class, S-2 (6-8-6 wheel arrang ment) is a geared-turbine non-condensing steam loc motive. It has a conventional-type fire-tube boiler ca able of supplying 95,000 lb. of steam per hour at 3 lb. per sq. in. boiler pressure or 285 lb. per sq. in. boil pressure and 750 deg. F. total temperature to the turbi nozzles. With this steam flow, the turbine unit develo 6,550 hp. at the rail at 70 m.p.h. and less at other spee

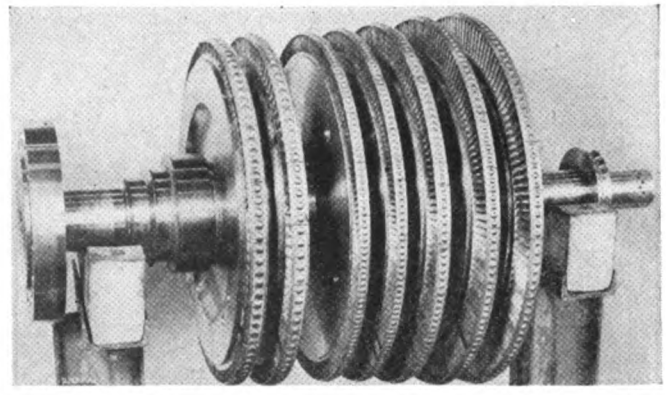
Integral Power Unit Assembly

The propulsion unit and controls include a forward t bine, a double-reduction gear for each of the two mid driving axles, flexible cup-drive elements between t final drive gears and the two middle driving axles, reverse turbine and gear unit clutched to the single hi speed pinion, a pneumatic steam-admission control w overspeed and low-oil-pressure protection, and oil-syst auxiliaries including a cooler, magnetic and metal e strainers, two turbine-driven pumps and control val

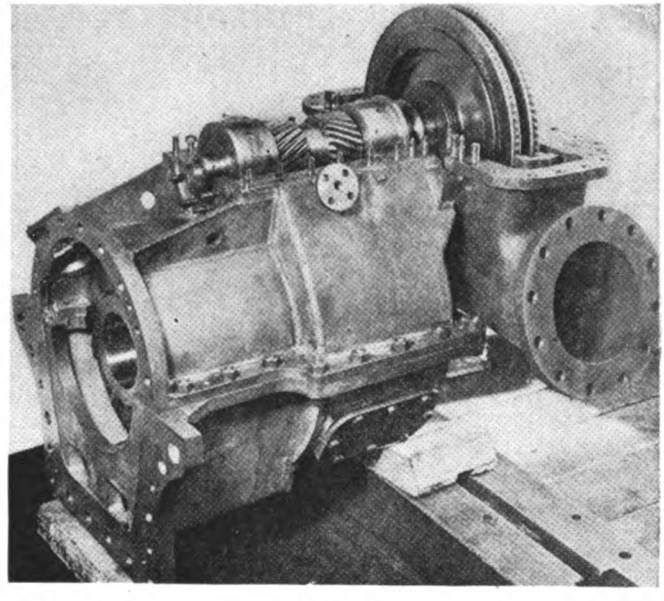
Both turbines are supported from the gear case whi in turn, is supported from the main locomotive fra making the power unit a complete assembly in its The gear case is supported from the locomotive frame

General Dimensions, Weights and Proportions of the Pennsylvania 6-8-6 Direct-Drive Steam Turbine Locomotive

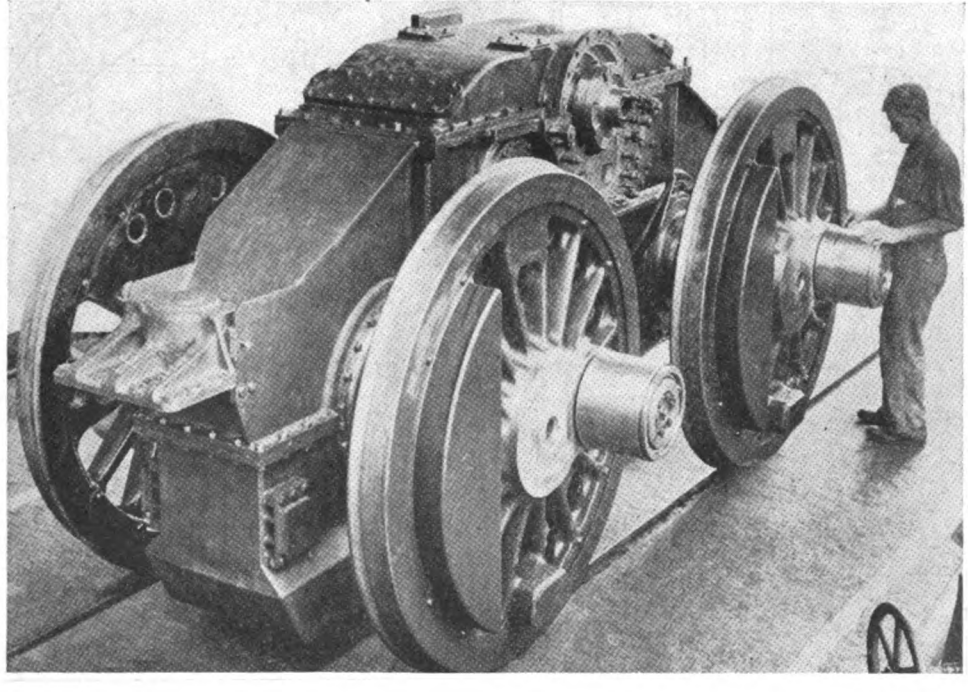
Railroad	Pennsylvania
Builder	Pennsylvania-Westinghouse-Baldwin
Type of locomotive	6-8-6 general turbine
Road class	S-2
Date built	1944
Service	Passenger and freight
Tractive force; lb.:	
Forward	70,500
Reverse	65,000
Weight on drivers ÷ tractive force:	
Forward	3.69
Backward	4.00
Wheels, driving, diameter outside tires, in.	68
Weights in working order, lb.:	
On drivers	260,000
On front truck	143,000
On trailing truck	177,000
Total engine	580,000
Tender	449,400
Wheel bases, ft.-in.:	
Driving	19 - 6
Rigid	13 - 6
Engine, total	53 - 0
Engine and tender, total	108 - 0
Turbine characteristics:	
Steam conditions:	
Pressure at turbine inlet, lb. per sq. in. gauge	285
Steam temperature at inlet, deg. F.	750
Back pressure at turbine exhaust lb. per sq. in. gauge	15
Ahead turbine:	
Nominal rated capacity, hp.	6,900
Maximum turbine operating speed, r.p.m.	9,000
Overspeed governor controlling speed, r.p.m.	10,000
Reverse turbine:	
Nominal rated capacity, hp.	1,500
Maximum turbine operating speed, r.p.m.	8,300
Overspeed governor controlling speed, r.p.m.	9,100
Main reduction gear:	
High-speed ratio	31 : 160
Low-speed ratio	31 : 111
Total reduction	18.5 : 1
Boiler:	
Type	Modified Belpaire
Steam pressure, lb. per sq. in.	310
Diameter, largest outside, in.	102
Firebox length, in.	180
Firebox width, in.	96
Combustion chamber length, in.	120
Tubes, number and diameter, in.	49 - 2¼
Flues, number and diameter, in.	235 - 3½
Length over tube sheets, ft.-in.	18 - 0
Net gas area through tubes and flues, sq. ft.	11
Fuel	Bituminous
Grate area, sq. ft.	120
Heating surfaces, sq. ft.:	
Firebox and comb. chamber	530
Circulators (6)	84
Tubes and flues	4,378
Evaporative, total	4,992
Superheater	2,050
Combined evaporative and superheater	7,042
Tender:	
Water capacity, gal.	18,000
Fuel capacity, tons	37½



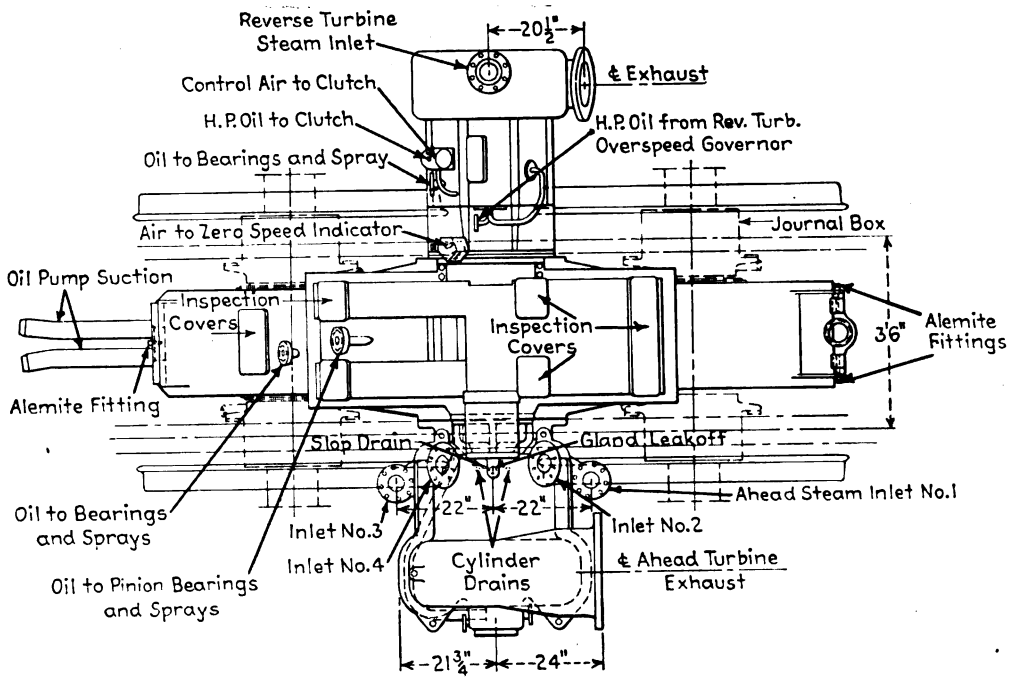
The forward turbine has an initial Curtiss stage (at the left) and five full-admission reaction stages—Cam-operated air valves control the steam to each of four nozzle groups—These valves operate in sequence

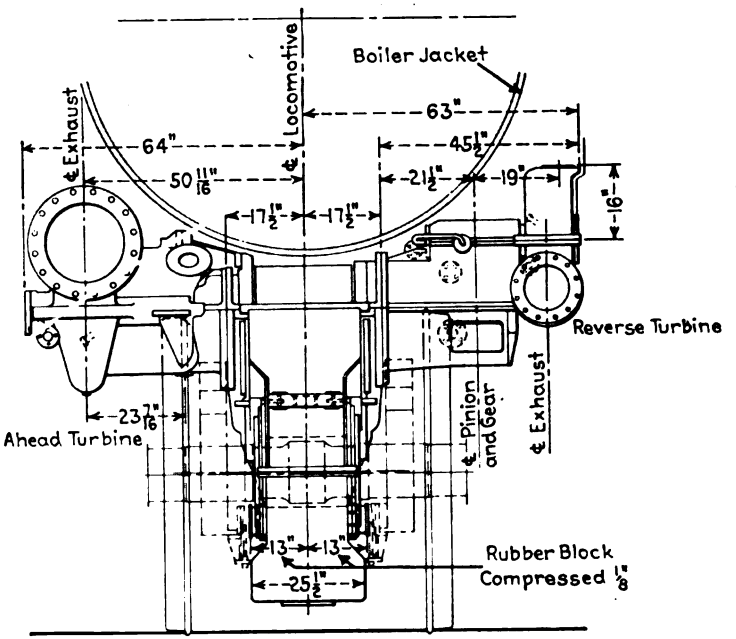


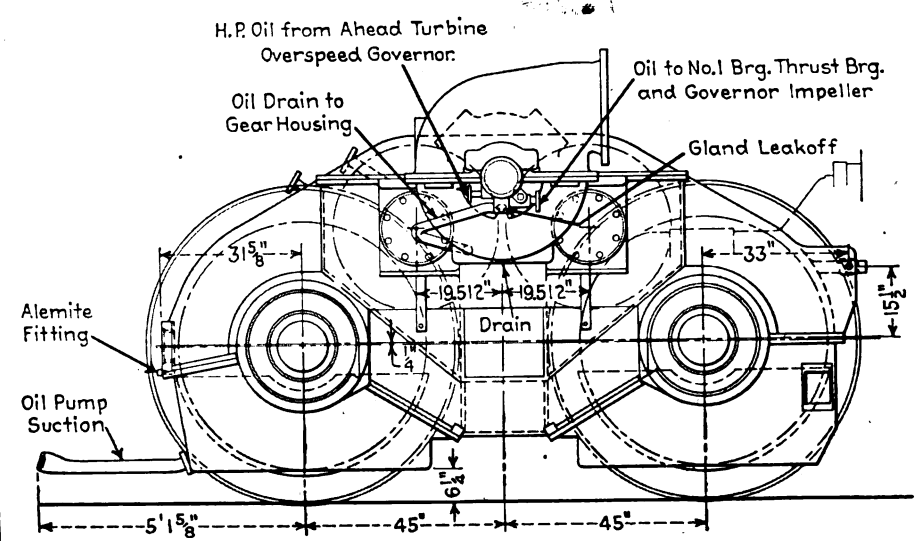
Overhung on an extension of the reverse-gear pinion shaft, the reversing turbine consists of a single Curtiss stage of 1,500 hp. capacity

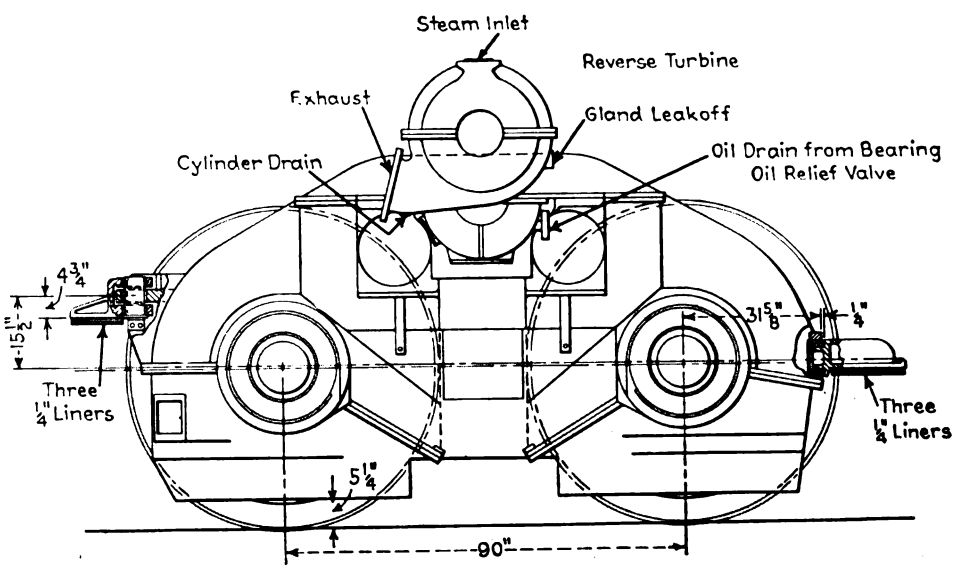


The transmission unit mounted on the two geared axles—The front is at the left—The clutch plate for the reverse drive is shown on the right of the gear case—This unit is supported on the locomotive frames









The gear case and steam turbines—The lower sections of the case act as oil sumps and can be removed to permit dropping the axles

three points (two at one end of the case and one at the opposite end) in such a manner that distortion of the locomotive frame is not transmitted to the gear case.

The forward turbine is of the impulse type and consists of a Curtiss stage followed by five full admission Rateau stages. Although especially designed to meet the severe temperature and load changes found in railway practice, it is similar to the high-pressure units of cross-compound marine plants. At 100 m.p.h. of the locomotive the turbine speed is approximately 9,000 r.p.m. It is connected to the high-speed pinion at the reverse-turbine side of the unit, a quill shaft extending through the pinion. Steam enters the turbine through four 3-in. pipes, each pipe being connected to a nozzle group covering approximately 25 per cent of the peripheral area of the Curtiss stage blading. Each inlet pipe is connected to a throttle valve and steam header located at the top of the smokebox. There are four cam-operated valves for control of steam to the forward turbine, each valve controlling the flow of steam to one of the four inlet pipes. The cams are arranged to open the valves in sequence. Close regulation of locomotive power and speed are obtained by opening each valve in small increments.

The reverse turbine is a single Curtiss stage, overhung on an extension of the reverse-gear pinion shaft. Steam is admitted to nozzles in both the base and cover of the reverse turbine cylinder through a single inlet pipe, connected to the reverse throttle valve, also cam-operated, and located adjacent to the forward turbine valves. The maximum locomotive speed in reverse is 22 m.p.h., at which speed the turbine develops 1,500 hp. at approximately 8,300 r.p.m.

The maximum starting tractive force in reverse is 65,000 lb., or 25 per cent adhesion. This is made possible with the small reverse turbine and only a third of the steam flow of the forward turbine by the addition of the reverse gear which multiplies the torque of the reverse turbine by four at the high-speed pinion.

Power in reverse is transmitted to the main-gear high-speed pinion through a hydraulically actuated positive engagement clutch. The forward turbine is solidly connected to the high-speed pinion, but the reverse turbine is engaged with this pinion only during operation in reverse. Engagement or disengagement of the clutch when the locomotive is moving is prevented by a "zero speed" interlock in the pneumatic control circuit. The reverse turbine, the reverse gear and the movable clutch half are shown in two of the illustrations.

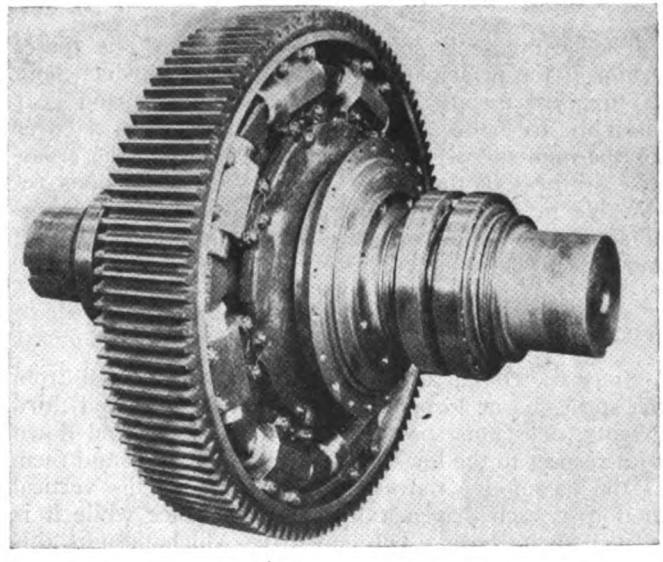
Single Lever Control

One lever at the right of the cab is used to control speed as well as direction of the locomotive. The complete motion of the lever is the same as that in shifting one's private automobile from "low" gear to "intermediate." The neutral position of the gear shift is the "off" position for the locomotive. Moving into "intermediate" controls the steam flow to the forward turbine; moving into "low gear" engages the clutch and controls the flow of steam to the reverse turbine. The control consists of a forward pneudyne (an air-relay-controlled pneumatic cylinder) located on the engineman's side of the locomotive, a reverse pneudyne on the fireman's side of the locomotive, overspeed and low-oil-pressure-protection valves and a zero-speed interlock. The pneudynes, through a rack and pinion forward and a lever in reverse, rotate the throttle-valve cam shafts and thereby control steam flow to the turbines. If either turbine over speeds (110 m.p.h. forward, 25 m.p.h. in reverse) or if the lubricating oil pressure falls below 5 lb. per sq. in., the protection valve operates to close either throttle by exhausting the control air to atmosphere. The control was supplied by the Westinghouse Air Brake Company.

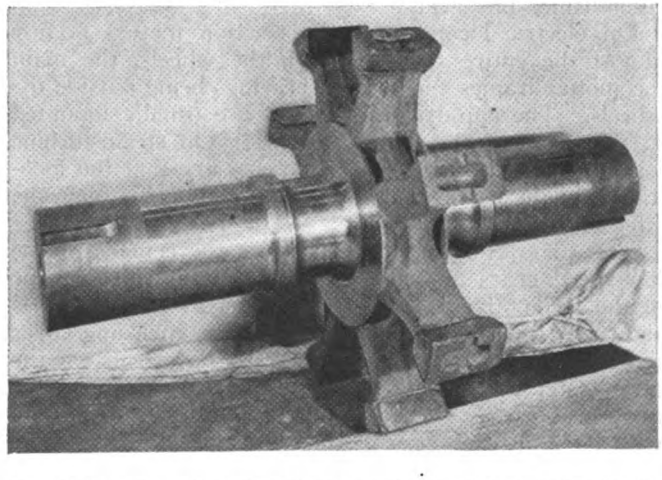
Unusual Gearing

The main gear is a double-reduction unit designed to transmit power to the No. 2 and No. 3 driving axles from a single high-speed pinion. Transmission of equal torques to each of the driving wheels is assured by side rods connecting the four driving wheels on each side. The gear is of the nested type with two double helical high-speed gears, two low-speed spur pinions, two low-speed spur gears, and two cup-drive elements all housed in an enclosed fabricated steel gear case. The high-speed pinion and the second reduction gearing is hardened and ground. This is the first commercial application of hardened and ground double helical gearing. The tooth loading and contact hardness (450 Brinnell) of the high-speed pinion are more than twice the values commonly used. The first reduction gears are hobbed from material also nearly twice the hardness commonly used.

The development of a method of grinding double helical gearing with the extreme accuracy required is the first



The main elements of the drive are a spider which is pressed and keyed on the axle, a quill which houses the axle with approximately 1¼ in. radial clearance, and the spring-cup assemblies eight of which are mounted around the inner diameter of the gear



The driving axle and spider—The arms of the spider are faced with Stellite plates

major advance in this type of gearing since the first gear was built by George Westinghouse in 1909. Grinding is effected with a flat wheel in combination with a novel grinding rig designed and developed by the Westinghouse Steam Division. Although materials of the usual hardness might operate satisfactorily in an application of this kind, an additional factor of safety is introduced by the use of the harder, stronger gear-tooth material. Further development and use of this new grinding technique may make possible real savings in the weight and space of double helical gearing for many high-speed high-power turbine drives.

Bearings for the high-speed pinion and the high-speed gears are tin base babbitt lined. Clearance greater than usual are required for the high-speed pinion bearings because of their high rubbing velocity. The high-speed gear bearings are novel in that they rotate with the pinion and gear, being fitted into the hollow-bored low-speed pinions on which the first reduction gear wheels are shrunk. The bearings rotate upon trunnions which center the second reduction pinions. The low-speed gear bearings are of the anti-friction-type duplicate of those furnished as quill bearings for electric locomotives.

Split Gear Case

The gear case is split into four pieces. The center section is the principal structural member to which both the forward turbine and the reverse turbine and gear assembly are bolted. The upper section forms a cover for the high-speed gearing and contributes to the crosswise stiffness of the case. The two lower sections removable to permit dropping the axles are lubricating-oil sumps as well as enclosures for the low-speed gearing and the cup-drive assemblies.

Cup-Drive Used

Since the complete propulsion unit is supported from the spring-borne locomotive frame the second and third driving axles must be permitted to move up and down with respect to the low-speed gears which surround them as the locomotive moves over the rails. This vertical motion of each driven axle must take place while it is turned by its gear. The cup drive which permits this motion is really a misalignment coupling between the low-speed gear and the locomotive axle. This development is used on most main-line electric locomotives, and while the Class S-2 cup drive is the same in principle as the drives used on electric locomotives, it bears little resemblance physically.

On electric locomotives, the traction motors occupy almost the entire space between the wheels, the main locomotive frames and journal bearings being outside the wheels. The cup-drive assemblies are usually mounted in the plane of the driving wheels. On steam-turbine locomotives with side rods it is necessary that the locomotive main frame and the cup drive be between the wheels.

The Class S-2 cup drives occupy the centers of the low-speed gears and are on the longitudinal centerline of the locomotive. They are compact assemblies, as is shown by the photograph taken with the enclosing cover removed. The "quill" becomes two short seats on the gear center for roller bearings which are carried in the main gear case. There are two rows of cup assemblies, with eight in each row. Since the quill cannot extend to the driving wheels, as in the case of the electric locomotives, a drive spider is pressed on the locomotive axle, at its center, and the gear torque is transmitted by the eight spring-cup assemblies to the arms of this spider.

Two major departures were made from conventional cup-drive design to enable the Class S-2 drives to withstand the heavy duty imposed on them by having to transmit power to all four axles.

The cups are made in two pieces, with self-aligning inserts which distribute the spring loads over relatively large areas of contact with the drive spider arms. The whole drive is enclosed by oil-tight cover plates so that the entire mechanism is kept clean and well-lubricated with a bath of heavy extreme-pressure lubricant.

The cup drives, in addition to permitting the up-and-down motion of the driving axles, are torsionally flexible. This protects the gearing and turbines from shock loads. It would also mean that, if the driving wheels on one of the two geared axles were larger than those on the other, that axle would tend to "hog" the load. To prevent this, and to force an equal division of power flow to each of the geared axles, side rods have been provided between No. 2 and No. 3 driving axles. All side rods on this locomotive are fully balanced, so that the dynamic augment inherent in reciprocating locomotives is eliminated.

Lubrication

All turbine and gear bearings and the gear teeth are lubricated with the same oil, a high-grade turbine oil having a viscosity of 500 sec. Saybolt Universal at 100 deg. F. The system contains approximately 150 gallons, and the entire quantity is recirculated by one of two small turbine-driven Gould centrifugal pumps. One pump is for normal duty and the second one is an emergency standby. Oil is pumped from the gear case through a magnetic strainer and oil filter to a surface-type oil cooler, cooled by boiler feedwater, and then to a distributing manifold equipped with a steam-heating coil before being piped to the bearings and gear sprays.

A regulator maintains a constant oil pressure of 15 lb. per sq. in. on the bearings and sprays. The pump discharge pressure is 60 lb. per sq. in., high-pressure oil being required for the hydraulic cylinder which is used to engage the reverse clutch.

A Look Back and Ahead

The basic engineering ideas in the S-2 locomotives are the result of many years of study and development. Turbines have been applied abroad to steam locomotives. Some turbine locomotives have been successful and a few are still in service in Europe. Probably the most successful one is the 2,000-hp. non-condensing engine of the London, Midland & Scottish, placed in service in 1933. Since that time it has operated in express service between London and Glasgow over the same route as such famous trains as the Coronation Scot. The performance of this locomotive has been creditable. However, its power is insufficient to make it economically competitive with the efficient compound reciprocating locomotives used on the L. M. S. Locomotives for railroads in the United States require two or three times the power of those used in England, and American railroads use the less efficient but simpler and more reliable single-expansion engine. These factors make the turbine locomotive more attractive here than in England.

The Pennsylvania Class S-2 locomotive has been undergoing tests on the railroad in both passenger and freight service. Continued operation in revenue service is contemplated to prove fully the mechanical adequacy of the design.

Diesel Electrical Repairs

By P. H. Hatch*

An outline of the facilities required for the maintenance of the electrical equipment of Diesel-electric locomotives and the methods that are used —This completes a series of three articles the first of which appeared in the January issue

IT HAS already been pointed out that for various reasons maintenance programs and facilities for Diesel-electric locomotives in respect to Diesel engines and mechanical parts lagged a number of years behind the actual application of such locomotives to service. Probably due to the fact that electrical equipment has the inherent ability to keep going under such conditions quite a way beyond the economic limit for deferred maintenance, it was about the last to receive serious consideration in the way of programmed attention and the requisite facilities. Under the impetus of the wartime expansion in the use of Diesel-electric motive power, intensive study was given the matter of electrical repairs. It is, of course, true that some railroads have already installed the necessary facilities and a fortunate few (as previously mentioned) were already equipped for maintaining electric locomotives or multiple-unit equipment or both and thus could take on electrical work on Diesel-electric locomotives without delay.

There is the further fact that even had all the necessary facilities been generally available from the start, the methods to be used in the maintenance of the electrical equipment had in a number of important respects to be developed as dictated by service experience. This was particularly true in the case of Diesel-electric road locomotives. For example, who could predict what repair procedures would have to be adopted for traction motors and at what intervals when the motors were first used in high speed, streamlined train service? As a matter of fact, the design of these motors itself was by no means in final form at this stage. Hence the two basic factors necessary for estimating maintenance requirements—the service of the equipment and its design—were both uncertain.

With millions of miles of service already accomplished and designs more or less stabilized today, however, the maintenance pattern has begun to take definite shape as illustrated by the following general comments applying to various major items of the electrical equipment, the treatment of which at shoppings is presumed to be along lines similar to those assumed for Diesel engines and locomotive mechanical parts.

The Main and Auxiliary Generators and Exciters

Being directly connected to the Diesel engines and therefore located in the hoods or engine compartments, traction generators are subject to dust and dirt, oil fumes or smoke and relatively high ambient and cooling air temperatures. Depending on margin of design and load factor of the service, they may also be subject to high temperatures resulting from electrical loading. Having customarily a single outboard bearing, mechanical conditions may also be severe. Being directly connected to the prime movers in locomotives, a main generator failure is in itself serious since in the case of a single-power-plant locomotive it ties up the entire locomotive and in the case of multiple-power-plant locomotives it will cause at least a substantial reduction in capacity, and it may involve the engine itself in serious damage. Under these conditions the only answer to satisfactory main generator performance is close attention in service and adequate maintenance at shopping times.

The amount of such maintenance work which should be done at one time varies between switching and road locomotives and in both cases depends also on the severity of service. Particularly in the case of switching-locomotive main generators, a program of thorough cleaning of armature and field, painting of armature string band, checking of field-coil and brush-holder connections with necessary retaping and painting, detailed inspection of brush holders and brushes with necessary repairs or replacements, general inspection of commutator, checking of bus bars or leads and testing can be adopted to alternate with a heavier program. All of this is work which can be done without removing the generator from the engine.

The heavier program requires removal of the generator from the engine and its complete dismantling. The principal purpose is to turn the commutator, inspect, clean and repack the roller bearings, examine the bearing housing in the end frame and thoroughly clean both armature and field windings by wiping or the use of a suitable solvent, using compressed air with care and being sure to remove all traces of solvent, dipping and baking armature and field as necessary and rebanding the armature. This constitutes a medium-heavy-repair job and is usually done when the commutator requires turning. It, of course, includes the work done in connection with the lighter, intermediate class of repairs.

It is possible to avoid dismantling the generator by turning or grinding the commutator in place. While in many cases this is standard practice, it is believed that more accurate and uniform results can be obtained by turning and polishing in a lathe, thus conserving commutator material and prolonging its life. This method, while admittedly taking longer and being more costly, affords the further advantages of being able to check the main bearing and to clean insulation thoroughly and dip and bake if required.

Regarding the latter, it is considered better practice to dip and bake only if the condition of the insulation requires this treatment, otherwise resorting to cleaning and possibly a light spray coating of insulating varnish (or,

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in the case of the armature, a "rolling" in such varnish) only. Needless dipping and baking adds useless material to the windings which will decrease heat transfer and reduce the area of ventilating air passages. As to how to determine whether dipping and baking is required, usually detailed inspection by an experienced man in conjunction with megger readings is all that needs to be done.

In the case of generators in road locomotives, the intermediate lighter program of repairs will usually be omitted in favor of the heavier program which will be required more frequently than in the case of switching-locomotive generators because of more continuous heavy duty. Thus, at certain intervals determined by commutator conditions or other considerations, the generators will be given repairs in accordance with the heavier program described.

Complete rewinding of generators, renewal of commutators, etc., in the absence of fires, major insulation failures, bad flashovers or mechanical damage will be a long-term necessity, assuming proper and adequate design in the first place. What this long-term period will actually turn out to be is at present more or less indeterminate.

One of the most controversial subjects in connection with electrical repairs is high-potential testing of insulation dielectric strength to ground and this problem is very much present in connection with the maintenance of main generators on Diesel-electric locomotives. Under the effects of heat, dirt or moisture, or a combination of these, strength of insulation deteriorates in service and it becomes a two-fold problem in any repair program. One part of this problem is testing before repairs are made to determine if any special work is necessary or if there are any weaknesses present, and the other part is testing after repairs to make sure the generator is in suitable condition for the normal period of service before the next shop attention. The ultimate solution is usually based on the manufacturer's experience and recommendations modified by the railroad's own experience and service results. It goes without saying that it is uneconomical to break down insulation needlessly and it is equally uneconomical not to determine as far as possible by test the condition of the insulation before release from repairs. In this connection, it may be found of material assistance in working out a scale of test high-potential values to use to base them on preliminary insulation resistance values determined by megger readings. Thus any machine or winding not having the prerequisite insulation resistance would not be subjected to a high potential test voltage which in all probability could be expected to break it down.

Before leaving the subject of testing, mention should be made of high-frequency testing to determine the strength of insulation between turns, which is especially useful when applied to apparatus which has been rewound.

Auxiliary generators are low voltage machines either directly connected to the main generator or belt driven from the Diesel engine or its auxiliaries. By means of voltage regulators their voltage is held constant over a wide range of engine speeds. While in a number of earlier switching locomotives they were called upon to furnish all locomotive power, including that for radiator fan motors, air compressor or compressors, traction-motor blowers, battery charging, control, excitation and miscellaneous small motors, in later designs of both road and switching locomotives they furnish power only for battery charging, control, and miscellaneous small motors and their size has, therefore, been correspondingly reduced.

Auxiliary generators require the same kind of repairs as already described for main generators, but being of small capacity and low voltage, such repairs are needed only at extended intervals and they can usually be taken care of in connection with the occasional repairs of the heavier type to main generators.

With the exception of a series winding carrying main generator armature current (if used) exciters are also low voltage machines of small capacity. They are usually belt driven from the Diesel engine or its auxiliaries and the same general repair considerations apply as for auxiliary generators.

Motors — Traction and Other

With few exceptions, traction motors are axle and truck mounted and the drive to the axle is by means of a single pinion and gear enclosed in a gear case. Spring support on the truck-frame cross member or center-plate assembly is usually provided for the motor nose, and the opposite side of the motor frame includes two housings for bearings which rest on journals on the axle between the gear and the opposite wheel. Usually the motors are force ventilated through ducts in the body and truck center plate assemblies.

From these facts certain conditions are immediately apparent. Traction motors are only half spring supported and are therefore subject to a combination of direct and spring damped blows. They are exposed to all of the heat and dust of the roadway or yard at various times and to snow or moisture at other times. In accordance with present design arrangements, cooling air is usually taken from the hood or engine compartment and hence may include dust and dirt, oil fumes or smoke and may also have a relatively high temperature to start with. It can thus be seen that if the locomotive—either switching or road type—is to be operated at its full rated capacity for any length of time under these conditions, design of traction motors must be adequate in the beginning and maintenance must be adequate thereafter if satisfactory service is to be obtained.

While it is necessary to recognize a distinction between traction motors used in switching locomotives and those used in road locomotives this tends to involve different periods or time intervals rather than maintenance procedures. For example, the work done by a traction motor in a road locomotive is many times that done by a similar motor in a switching locomotive over a given period and hence more frequent and active attention is required. The kind of repair attention, however, is generally similar and will be discussed here.

Probably the three most important factors governing traction-motor repairs from the standpoint of either time intervals or type of repairs required are cleanliness, roller bearings and commutators. Any service factor therefore, which affects any one or all of these items will affect the entire maintenance picture for motors in that service. Conversely, the maintenance program must take these three factors into account and prevent trouble which might develop from any or all of them.

Traction-motor repairs, therefore (as distinguished from current routine attention and eliminating such long term items as complete rewinding, renewal of commutators, etc.), will be along the following lines:

On removal from the trucks the motors must be dismantled for detailed examination of commutator, armature winding, field windings, brushholders, connections, leads and armature roller bearings and their housings. All oil and dirt must be removed by wiping or by the use of a suitable solvent, using compressed air with care

and being sure to remove all traces of solvent. Restore commutator surface, preferably by grinding; dip and bake both field and armature as necessary and reband the latter. Inspect brushholders and make necessary repairs and check over all connections and leads, cleaning them as required. Examine armature roller bearings and clean and repack. On completion of repairs and prior to reassembly, the armature should be dynamically balanced if the motor is of the modern, high-speed type and used in road service. Axle bearings should be inspected and rebabbitted or renewed.

In the foregoing it is, of course, understood that if a motor has sleeve armature bearings these should be renewed or rebabbitted as required, and the armature-shaft bearing surfaces should be checked.

The same comments apply to dipping and baking of traction-motor windings as for similar main-generator parts, also the same considerations apply to dielectric testing before repairs and after repairs are completed. Regarding commutator grinding, methods have been developed for doing this with the motors in place in the locomotive. While this may serve as an emergency means for restoring commutator surfaces in service without having to remove and dismantle the motors, it is not recommended as a shopping procedure.

When a traction motor has gone through repairs of the type just described, some railroads prefer to run them light at reduced voltage before installation in trucks for the purpose of checking operation and to detect any incipient bearing trouble.

In the case of locomotives with electrically driven auxiliaries, the radiator-fan motors, air-compressor motors and traction blower motors should receive the same general type of attention as described for auxiliary generators and exciters, the intervals at which such attention is given varying with the service the locomotive is in.

Fuel-transfer-pump motors, water-transfer-pump motors, motor-generator sets, steam-generator main motors, etc., should be removed for reconditioning, or should be replaced with reconditioned units at the shopping times of these units.

Control Equipment

Reversers should be removed for dismantling, cleaning, lubrication, and repairs. Piston packing should be renewed, pinions and racks examined for wear and magnet valves cleaned and tested. Contact segments should be renewed or built up and re-machined. Stationary contacts, shunts and springs should be inspected for overheating or wear and replaced as necessary. Contact tension should be checked and adjusted and interlocks inspected.

Contactors should likewise be removed for dismantling, cleaning and repairs. Tips should be dressed up or renewed, arc chutes should be repaired or replaced and interlocks inspected. Insulators should be cleaned and moving parts checked for wear. If of the electro-pneumatic type, piston packing should be renewed, cylinder walls lubricated, and magnet valves cleaned and tested. If of the electro-magnetic type, the operating coil and its connections should be inspected.

So many important locomotive functions depend on relays and regulators that it is good practice to remove them for thorough inspection and repairs, afterward adjusting them on a bench or test panel for proper pick-up and drop-out values of current or voltage in the case of relays or for holding the correct range of voltage in the case of voltage regulators.

Voltmeters, ammeters or load indicators should be removed for steaming, testing and calibration. This should apply also to engine or locomotive speed indicators of either the mechanical or electrical types.

Master controllers, push buttons, knife switches, etc., can be inspected and necessary repairs made on them without removal from the locomotive. Contact fingers and contact surfaces should be checked and necessary repairs or replacements made. The mechanical portions of the master controller, including the automatic safety feature, if used, should be inspected for wear and reconditioned if necessary.

Resistors should be inspected in place in the locomotive. Such inspection should include checking for overheating, poor connections or broken elements.

It is extremely important that cables and wiring be thoroughly inspected whenever a suitable opportunity presents itself in order to keep them free of collections of oil, grease and dirt and to repair insulation defects as they occur. This includes insulated bus bars as well as cobbs and wires and it applies of course to exposed sections and not to cables or wires in conduit. In the latter case reliance as to condition must be placed in the results of megger and high potential tests. Cleaning should be done by wiping with rags or the use of a suitable solvent; if a solvent is used, as mentioned in connection with repairs to main generators and traction motors, all traces must be removed. When the cleaning is completed, it is good practice to paint accessible sections, particularly those exposed to dirt, with a good grade of insulating paint which if possible should add to the moisture resisting and flame retarding properties of the insulation.

If any section of cobbs or wiring is found to have deteriorated excessively due to heat, it would be wise to consider relocating to reduce such exposure, as heat is one of the principal enemies of insulation.

Train-control or cab-signal equipment (electrical portion) will require general and specialized attention in accordance with the manufacturer's and individual railroad's requirements for electrical equipment of the type involved which is generally in a different category from other locomotive electrical equipment.

Conclusion

From the discussion of repair facilities for making mechanical and electrical repairs for Diesel-electric locomotives in this and the preceding two chapters it is apparent, in the first place, that a few items of heavy equipment conventionally used for railroad motive power are required, supplemented by a greater number of specialized smaller tools. It is apparent, in the second place, that the difference between a Diesel-electric shop equipped for running repairs and one equipped for repairs of a heavier or more extensive nature is principally one of degree and that a running repair headquarters can readily be designed to be expanded for heavier and more general repairs with a reasonable addition of tools and equipment. This is particularly true if manufacturer's "repair and return" facilities or their district service depots are utilized for the larger items of equipment. It is apparent, in the third place, that Diesel-electric locomotives by their construction and arrangement as an assembly of separate, integral parts lend themselves readily to a system of expedited, economical maintenance. And finally, given suitable and adequate design of locomotives and parts, it is apparent that the combination of preventive attention, proper facilities and correct methods can entirely remove maintenance as an unsolved problem in the use of Diesel-electric motive power.

OVER THE HILL WITH A DIESEL

By Walt Wyre
Part II

NED SPARKS watched the smoke of the passenger train fade into the distance and felt very much alone. The big 5400 horsepower Diesel was very silent. Every engine was dead. As long as Sam Wallace from the factory had been along, shooting troubles had seemed simple, but working alone made the job seem formidable.

Sparks looked at his watch—12:50. The locomotive was called for 1:35. The crew would be on it in thirty minutes or less. Sparks took a long breath and remembered what Wallace had reminded—don't ever get in a rush or panicky. Having thus bolstered his morale, Sparks began to do a little reasoning with himself. The alarm bells weren't ringing. Must be a blown fuse, he thought. He tested control circuit fuses in each unit and before he had finished testing them knew he was on the wrong track, because if one of them had been blown it would only affect that unit. Perhaps the control fuse at the switch in the cab was blown occurred to him. He tested that. It was O. K. After Sparks had replaced the fuse he sat down in the engineer's seat to think a moment. While sitting there he noticed the control switches, fuel pump switch closed; control switch closed; generator field switch open. That was as it should be. Of course it would be necessary to close the generator field switch before the locomotive would operate. His foot had been on the "dead man" control pedal. He rose to look in the engine rooms again. When he did he lifted his foot.

Sparks was opening the engine room door when he realized that there had been no whistle when he lifted his foot from the dead man control pedal. Then he was glad Wallace had not seen him. Any one should have known that the "dead man" had operated, which caused pneumatic control (P C) switch to open, stopping the fuel pumps, which caused the engines to die as they ran out of fuel.

The resulting opening of the control circuit was the reason the bells didn't ring as they had that morning when the overload trip operated and killed one of the engines.

Sparks set the air, then reset the P C switch and started the engines. He had the last one running and on the line when the engineer arrived. He then checked fuel, lube oil, and water. All were O. K.

BY COINCIDENCE, both the engineer and fireman were named Jones and not related. The fireman's first name was Frank, the engineer's was Earl. "Are you from the Diesel factory?" the engineer asked Sparks.

"Hell, no!" Sparks answered quickly. "I'm just a dumb electrician from Plainville. Have you had much experience on Diesels?"

"Very little on passenger and none on freights," the hogger grinned, "but I guess we'll get up the hill all right, and I know we can go down the other side. Guess our train is ready, the brakeman is giving me a back-up signal."

"If you'll show me about the shutters and fans," the fireman cut in, "I'll get them set."

"Good Lord!" Sparks groaned under his breath, "that makes our ignorance unanimous."

The engineer backed on to the train, the air was tested, and they were all set to go. The conductor came up carrying a sheaf of orders.

"How many buggies have we got?" the engineer asked.

"Sixty-nine," the conductor consulted a slip of paper, "thirty-one hundred and seventeen tons. Do you think you can make it with the 2842 helping?"

"Don't know," the engineer shoved the reversing lever into forward position, "but we can try."

The first twenty miles out of Sanford on the Mountain Division is not steep, then at Mountain View it takes off with a two per cent grade; twelve miles further the tunnels start, twenty-six of them including the big tunnel at the top over three miles long and up hill all the way.

Leaving Sanford, Sparks went through the engine rooms with the fireman and showed him about opening and closing the shutters. Wallace had instructed the previous fireman to leave both fans in and all shutters closed while the locomotive was standing. It had cooled off considerably from the time the engines died and Sparks came up, but was still warm enough for moderate work as it would be doing getting out of the yard.

"Never having been over the hill on a Diesel before, I can't say how the shutters should be," Sparks told the fireman, "but my idea is starting out about two shutters should be open, then when we hit the heavy grade at Mountain View I expect you will need to open another. It may take all four shutters open going up the hill. You can watch; if the engines start warming up, open shutters just a little at the time and the other way around if they start running too cool. One hundred and sixty-five is correct, I believe, and not lower than one-fifty nor more than one-eighty. The bells start ringing at two hundred."

"I'll watch them," the fireman promised.

Sparks walked through the engine rooms twice between Sanford and Mountain View. Everything seemed to be working smoothly and he sat down in the rear cab and began studying an instruction manual. He was reading the book when the train started up the heavy grade, but didn't notice it until he glanced at the speed indicator. It showed about thirteen miles an hour and the transition

meter hand was way over to the red portion of the meter. Sparks went along as rapidly as possible to the front cab.

"What's the matter?" Sparks asked the hogger. "We're not doing so good."

"This is about as fast as we usually make it along here." The engineer didn't appear to be bothered.

"That may be O. K. for a steam engine," Sparks said, "but at this rate the traction motors are likely to get too hot. Do you suppose you could signal the engineer on the helper to shove a little harder?"

"Not much chance," the engineer said. "What do you think I'd better do?"

"Maybe you had better drop the throttle down in the seventh notch and get the transition meter out of the red," Sparks suggested.

"I'll drop off and catch the rear end and tell the engineer on the helper," the head brakeman who was in the cab said.

"That's a good idea," the engineer remarked.

A few minutes later the brakeman had evidently told the helper engineer. Train speed began to pick up. The Diesel engineer advanced the throttle to the eighth notch and continued to gain speed until the train was moving sixteen miles an hour and the transition meter hand well out of the red.

Hot air that stung nostrils and lungs rushed in

"It won't be long until we hit the tunnels," the engineer said a little later. "If there are any doors or windows open, better close them going through the tunnels to keep out smoke and gas."

Sparks went back to the rear cab to close the windows which were open. As he went through he looked at the oil pressure gauges and thermometers. The fireman seemed to be doing fairly well for a new man. Temperatures were around 165 degrees, the highest was under 170.

Sparks closed the windows of the rear cab and picked up the instruction manual. He was looking at a schematic diagram of the control wiring tracing the control interlock circuits when suddenly he was in the dark. They had reached the first tunnel. He reached around back of him, his hand fumbling for the cab light switch, but before he found it the locomotive was out of the tunnel.

It was very hot and stuffy in the cab and Sparks decided to go to the front end where perhaps it would be more pleasant. By the time Sparks had entered the engine room the locomotive was passing through another tunnel. The room became stifling hot in just a few seconds. Reverberation of the engine exhausts against the roof and walls of the tunnel intensified the noise until the sound waves seemed like something solid bombarding his ear drums.

For the first time in his life Sparks felt a panicky touch of claustrophobia, the fear of being closely confined. Instead of looking at oil gauges and thermometers as he had intended, he rushed towards the head end of the locomotive. By the time he had gone through two units light showed through the windows, the engine noise became normal and Sparks opened a side door and gulped a lung full of air fresh and cool from the mountains. Temperature of the No. 2 unit was slightly over 170 degrees, while that of the number one was a little lower.

"How are they running?" the fireman asked when Sparks entered the cab.

"Look O. K.," Sparks replied, "that is the first two. To tell you the truth, it was so hot and stuffy in the rear units coming through the tunnel that I didn't stop long enough to look at the temperatures, but they have all been running about the same so far."

"She sure runs nice," the engineer said. "We've been making between sixteen and seventeen miles an hour ever since the helper picked up his feet and started pushing. We'll have to stop at Ozona for the helper engine to take water. Guess we won't need water this trip," he added.

It was decidedly more comfortable in the front cab than in the rear. Besides being cooler there was no smoke and gas, and Sparks was beginning to enjoy the ride. He had been over the Mountain Division before, but never in the front cab of a Diesel where he could get such a broad view of the rugged mountains and deep valleys. Patches of snow on the mountains ahead showed how rapidly they were gaining altitude and the scrubby cedars gave way to pine and fir with patches of scrub oak. A tumbling mountain stream dashed itself into a froth against the rocks as it rushed crookedly down the mountain side. The track following close to Nature's survey was almost as crooked as the stream. Once Sparks looked out of the window and glimpsed the rear end of the train and the helper engine going in the opposite direction to the Diesel. At first he thought it was another train they had met.

"Three miles to Ozona," the engineer remarked. "The next tunnel is the longest one we have until we get to the top. It's nearly half a mile long."

The mouth of the tunnel mentioned could be seen across a curve. The hole looked awfully small viewed at an angle. About half way through the tunnel the bells started ringing steady and insistent. Sparks and the fireman both started at once, Sparks in front, the fireman following. Inside the engine room the bell was louder. The hot-engine light gleamed. The thermometer of the first unit stood below 165 degrees. The second unit was about five degrees hotter.

As before, when passing through a tunnel, the noise and heat filled the engine rooms, but Sparks, intent on the job at hand, was not so affected. As they progressed towards the rear the heat became more intense and thermometers showed correspondingly higher. The third unit was approaching the danger mark, the hand stood at 190 degrees.

"Must be the fourth unit," Sparks yelled and pointed. The engine noise shoved Sparks' words down his throat, but the fireman understood the gesture.

It was the fourth unit. The thermometer hand had passed 200. Three shutters were open. Sparks opened the fourth wide as the lever would allow, but the bell continued to ring. The fireman stood helplessly watching, then trying to do something helpful opened a side door. Hot air that stung nostrils and lungs rushed in. The fireman hastily closed the door.

Opening the fourth shutter apparently had no effect. The bell continued to ring. The hot-engine light still shone and instead of going down the temperature continued to go up. Sparks remembering what Wallace had told him that no harm would be done by the temperature reaching 200 was not much worried and two or three degrees more wouldn't matter, he figured, until he noticed that water in the gauge glass had dropped about three inches. Then he pulled the lay shaft lever bringing the engine to idle and threw the isolation switch, taking the engine off the line. The train immediately began to slow down. The alarm light went out and the bell stopped ringing when the isolation switch was thrown, but started again in about thirty seconds.

At first Sparks couldn't figure why the bell started ringing, then he remembered that the third unit was getting hot when he came through it and in the rush neither he nor the fireman had thought to open the shutter. Sparks went rapidly as he could walk and opened the shutter. The water glass still showed full, for which he was thankful.

By then the locomotive was through the tunnel and the third unit began cooling immediately. The bell stopped ringing and the light went out but the train had slowed almost to a crawl.

Sparks went back to the fourth unit which was still off the line and the engine idling. The water glass showed slightly over half full and about four inches above the low water level mark.

Sparks hesitated, then decided to put the engine back on the line before the train was stalled. Holding the lay shaft lever to allow the unit to pick up the load gradually, he threw the switch.

"How far is it to Ozona?" Sparks placed his mouth close to the fireman's ear and yelled.

"Little over two miles," the fireman told him.

"Any more tunnels?"

"Yes," the fireman nodded and held up two fingers. "Short ones," he managed to make Sparks understand.

Sparks opened the two side doors to allow fresh air into the engine room. He looked at the thermometer. The hand was down below 180 degrees, but when the engine had gained full speed the water in the glass

dropped two inches below half way but it was still above the low level mark.

The locomotive with all units working soon regained the lost speed and was doing nicely up the hill. They came to another tunnel and while going through it the temperatures of the fourth unit rose a few degrees but not enough to hurt.

The tunnel was as the fireman had indicated short and they were soon through it. The fireman went back to the front cab but Sparks decided he had better remain and watch the fourth unit.

Sparks will never forget that two miles to Ozona. Accustomed to mile a minute speed on the Plains Division, the torturous sixteen miles an hour seemed painfully slow and the ten minutes it took by the time the train stopped at Ozona seemed over an hour.

"We will have to put some water in the fourth quarter," Sparks told the engineer.

"Well, guess we had better pull up to the tank," the engineer said. "How do you put it in?"

"I'll need a hose," Sparks told him, "but I guess they have one that is used for washing out ash pans."

There was a water hose at the tank but it had an iron pipe on the end to use for washing out ash pans. It took several minutes to remove the pipe so the hose would fit over the engine filter pipe underneath the car.

Having been cautioned about filling a hot engine with cold water, Sparks just partially opened the water valve and let the water run very slowly. It took thirty minutes to fill the tank, then fifteen minutes more for the engine to get warmed up.

"How is it from here to the top of the hill?" Sparks asked while waiting for the fourth engine to warm up.

"Not as bad as we have come over, there are more tunnels but no long ones until we reach the big one. It has fans to blow the smoke out."

•

THEY had no more trouble until the big tunnel. The fourth unit wasn't quite up to 150 degrees when they left Ozona. When it got to 155 degrees the fireman opened all shutters wide and did the same on the third. The second unit ran cool enough with three shutters open while the first only required two open the rest of the way up the hill.

Signal lights approaching Climax where the tunnel begins indicated they should take the passing track. When they pulled up to the tunnel the block was red. The brakeman climbed down and went to the telegraph office.

"There's a Mallet with a helper going through now," the operator told the brakeman. "You can follow soon as they get out."

"Ain't they going to blow the smoke out of the tunnel before we start?" the engineer said when the brakeman told him. "Why, the smoke will be so thick you can't cut it with a knife."

But evidently they were not going to wait to blow the tunnel. The signal light changed from red to yellow. The engineer swore, gave two toots of the whistle and reached for the throttle.

Smoke in the tunnel was like a solid wall moving before the Diesel. The headlight beam could not penetrate the murk. The train gained speed slowly. The engineer opened the throttle a notch, the wheel slip indicator light flashed. The train was only moving about ten miles an hour with the throttle in the sixth notch and each time the hogger tried to advance the throttle the wheels would slip. At one time the wheel slip light stayed on several seconds.

"Do you suppose we can make it?" Sparks asked.

"Don't know," the engineer shook his head dubiously. "There's a lot of smoke in here."

"What does the smoke have to do with it?" Sparks glanced at the speed indicator which still showed only ten miles an hour.

"Smoke has a lot to do with it." The engineer tried another notch on the throttle, but went back to the sixth to stop the wheels from slipping. "Coal smoke on the rails is just like grease. I've stalled with a steam locomotive and had to back out and wait for the smoke to clear before I could get through," he added.

Sparks stood behind the engineer watching the instruments. Every instant he expected an overspeed trip to operate and kill an engine which would no doubt have happened if the throttle had been in the eighth notch instead of the sixth. Anyway, they made it through the hole and every one in the cab sighed with relief when a winking signal announced they were approaching the end and topping the Continental Divide.

At Hillside, terminal of the Mountain Division, Sparks was relieved for rest and he was ready. He had been on duty nearly twenty hours and under nervous tension.

It was almost noon when he woke. Some one was knocking on the door.

"Come in," Sparks invited sleepily.

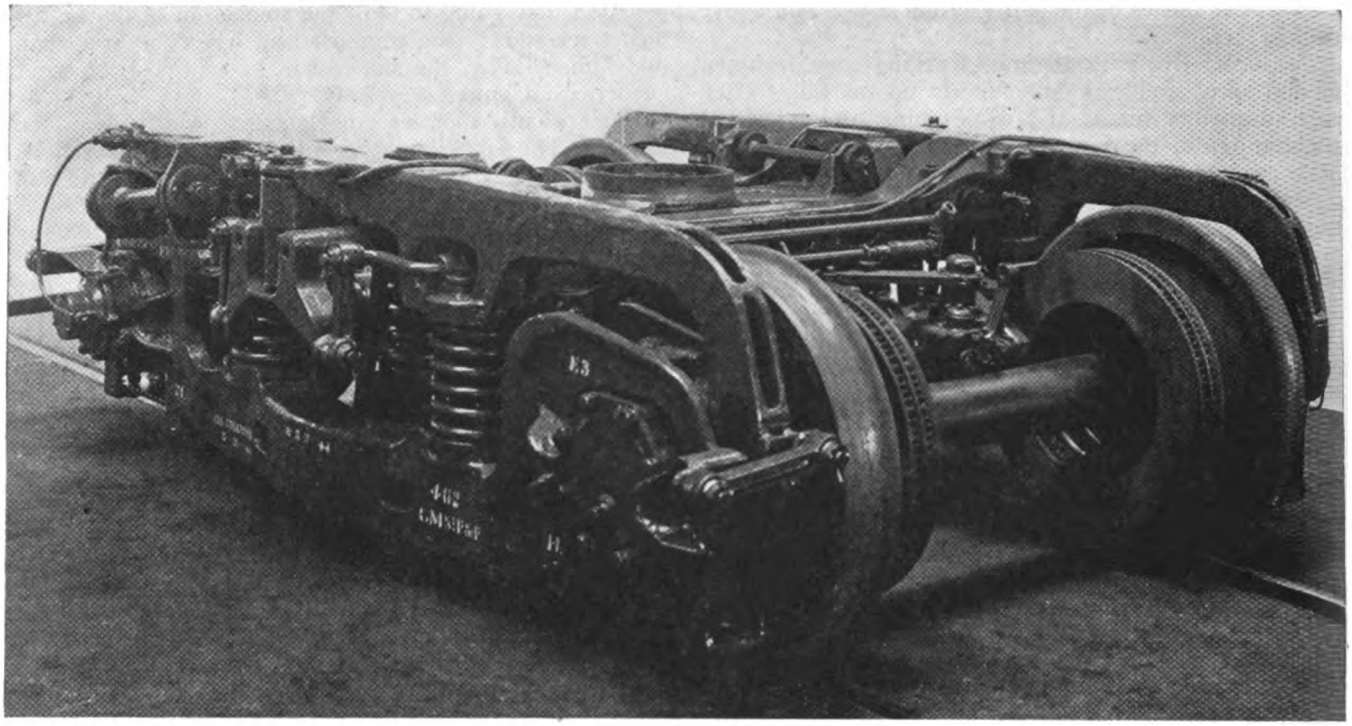
It was Sam Wallace. He had come around from the other direction on a Diesel pulling a troop train. "How did it go?" Wallace inquired.

"Not so good," Sparks lighted a cigarette. "We lost forty-five minutes taking water on the fourth unit at Ozona." Sparks told him about the trip up the hill, then added, "but I learned at least two things: the rear units get hotter going through tunnels, and, believe it or not, smoke in a tunnel can stall a locomotive."

* * *

Photo from Bureau of Locomotive Inspection

An overheated crown sheet on a freight locomotive caused the deaths of three employees—The explosion threw this boiler 304 ft.



Truck with friction contacts eliminated which was installed on Milwaukee coaches built in 1942

Milwaukee Develops

High-Speed Passenger Trucks*

By K. F. Nystrom†

Present-day demands are met by four-wheel roller-bearing trucks — Rubber cushioning reduces friction and aids in lowering noise level in cars

IN 1934, when the Chicago, Milwaukee, St. Paul & Pacific built its first streamline Hiawatha passenger train, which was placed in service May 29, 1935, more attention was given to the body construction and its appointments than to the trucks. Therefore, a conventional four-wheel truck was employed which proved to be lacking in riding qualities, particularly at high speeds. The four-wheel equalized truck with helical and elliptical springs, used under this equipment, is illustrated herewith.

As the need for an improved passenger truck was recognized in the following year, or in 1935, an experimental program was started, but, as no satisfactory solution had been found, the passenger cars built by the Milwaukee in 1936 were also equipped with conventional four-wheel trucks with minor improvements such as the use of more resilient springs.

Early in our experiments we found that personal judgment as to riding qualities could not be depended upon as conclusive, even from an experienced observer. Therefore, recording instruments were used and, in order to observe more closely the action of the truck at various speeds and service conditions, one vestibule step was removed and replaced with an observation booth from which also slow motion pictures were taken. Standard coaches were used in all instances and the final tests were made on both the main line and branch lines under customary operating conditions. By conducting these tests under such conditions we were able to duplicate closely a given test, particularly as we had a traveling engineer or a representative of the test department in the locomotive cab to cooperate with the locomotive engineman as to desired speeds. While the tests were being conducted the test coach was not made available to the public, as a number of instruments were used and it was necessary for the test crew to keep various records including recording of mile posts, location, speeds, etc.

When we felt the truck design was the best that could be produced at the time, the test coach was put in passenger service between Chicago and Mineapolis on the regular high-speed Hiawatha trains.

At that time there were strongly divided opinions

* This article is an abstract of a paper presented at the railroad session of the A. S. M. E. annual meeting, Railroad Division in New York.

† Mechanical Assistant to Chief Operating Officer, Chicago, Milwaukee, St. Paul & Pacific. Mr. Nystrom's title has recently been changed to chief mechanical officer.

throughout the country as to a choice between four-wheel and six-wheel trucks. We had selected the four-wheel truck because of the saving in weight; others used six-wheel trucks. To obtain some first-hand information, we made several test runs with a coach equipped with conventional six-wheel trucks. After this test was completed, the center pairs of wheels were removed from the test trucks and that portion of the load that had been carried by the two pairs of equalizers to the center pair of wheels was transferred to the outer pairs of wheels by the use of a special equalizer 11 ft. long, extending between the outer wheels. With the exception of applying larger axles, no other changes were made. Tests were duplicated with this four-wheel truck, but no difference in riding qualities could be observed when compared with the six-wheel test truck. These tests also demonstrated that an 11-ft. wheel-base four-wheel truck rode no better than an 8-ft. four-wheel truck already in service and previously tested. There was a preference for the four-wheel arrangement as its noise level was slightly reduced.

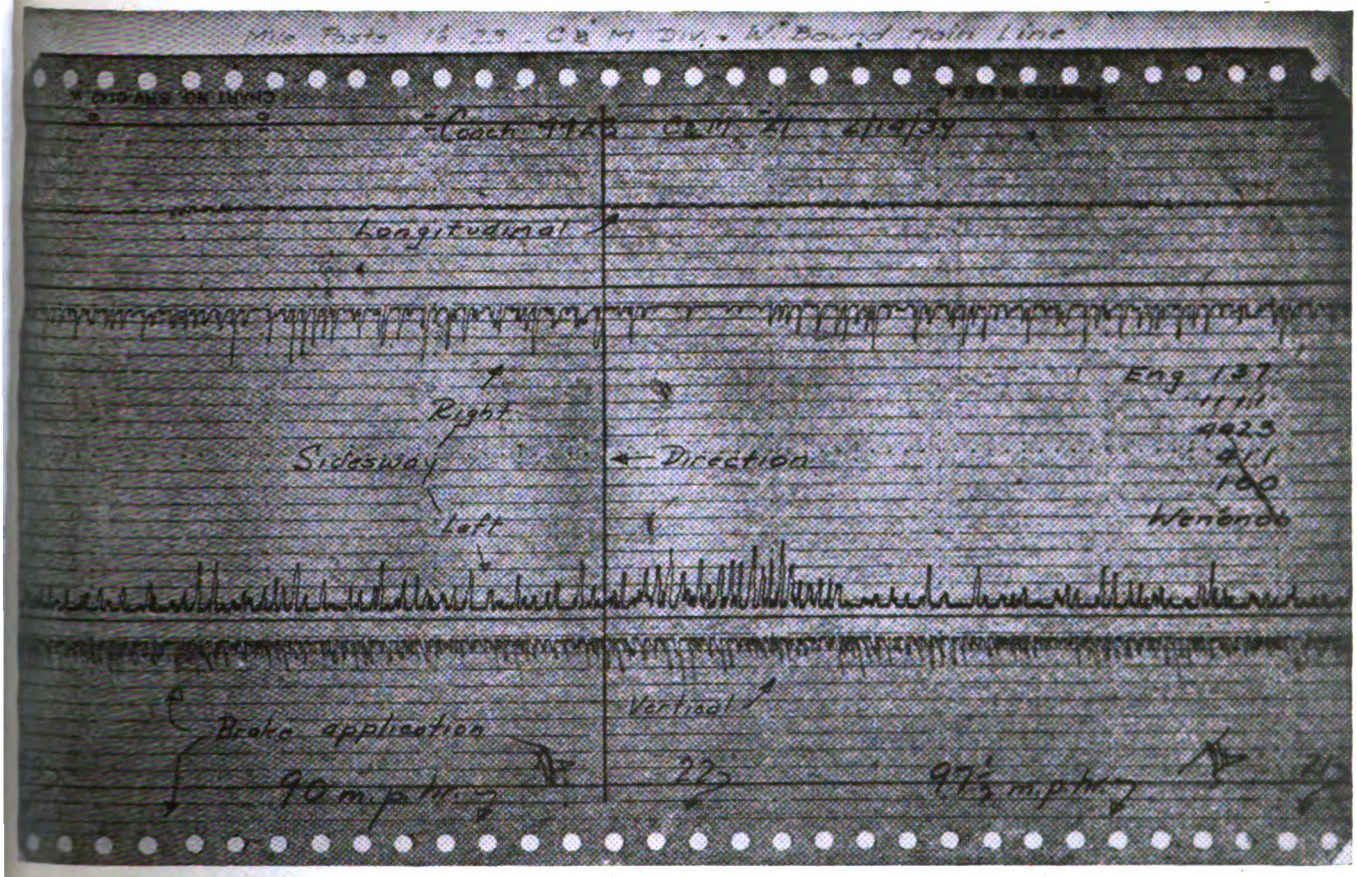
At this point it may be well to mention the great difficulty one person or a single railroad has in coming to logical and correct conclusions in tests or research of this kind as, at best, due to other pressing duties, only intermittent time and attention can be spared. Time is lacking to analyze test results carefully and premature and incorrect conclusions may be reached. As an example, in 1915, while with the Grand Trunk in Montreal, I developed a clasp-brake truck which was later extensively used. I strapped myself to a vestibule coach step for the purpose of observing the action of this truck and noticed that considerable lateral motion took place in relation to the journal boxes and allied parts. I came to the conclusion that a minimum of ¾ in. lateral clearance should be provided in a journal box, or an equivalent in roller-bearing boxes, and proceeded to design a dual roller-bearing box or housing providing for lateral clearances and self-aligning features.

While making a trip to Europe, mainly to get some new ideas, I discovered, to my disappointment, that the Southern Railway of England had in successful service, a four-wheel passenger truck wherein every effort was made to avoid lateral clearance. Although the dual roller-bearing box is still in successful service, later roller-bearing applications have proven that lateral clearance is not essential as far as roller-bearing applications are concerned.

With this explanation, it will be understood that any conclusion arrived at in this paper should not be considered as final. The only thing we can claim is that we have definitely improved the vertical riding qualities of passenger-car trucks, as actual records will show. These charts were taken on a three-way ride recorder which shows vertical, longitudinal and lateral acceleration; the bottom curve represents vertical acceleration. It is calibrated so that each .1 in. on the chart is .1 gravity with .02 initial tension. We are not satisfied with our accomplishments as we know there is room for further improvement.

Numerous Tests Made

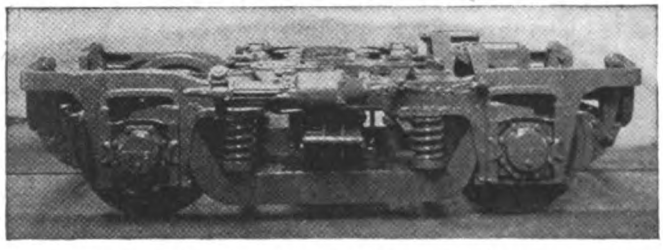
A large number of tests were made with various spring combinations and in 1936 a truck was designed somewhat similar to the European type. The bolster was supported solidly on a swing-hanger axis without springs. The swing hangers themselves were pin-connected to a spring-supported auxiliary bolster. The major portion of the springing of the truck was concentrated around the journal box. This type of construction later came to be known as a triple-bolster truck. The spring deflection had to be held



Ride recorder chart of a car equipped with four-wheel coil-spring trucks

so low under the swing hangers to maintain car body stability that it was abandoned as a high-speed truck, although this truck is still in service under a suburban car.

When our own initiative failed, as far as adopting European truck practice was concerned, we obtained drawings



Truck used under Hiawatha cars in 1934

and duplicated a truck generally used in Europe, known as the Gurlitz truck, which differed from the truck just referred to in that the triple bolster feature was eliminated and a single bolster employed, supported by semi-elliptic springs suspended by hangers from two wheel pieces. Extensive tests were made with this truck but it did not possess sufficient merit to warrant its adoption for high-speed service; however, it is at the present time operating under a coach in our suburban service.

We continued our experiments, working on the premise

1938 truck equipped with equalizers and without springs over the journal boxes

that a truck having the springs applied over or immediately at the journal box would be more desirable from a cost and weight standpoint. We therefore made extensive tests with a non-equalized truck using a single nest of coil-springs over the journal box. This truck was designed so that if the non-equalized feature was unsatisfactory an equalizer could be applied. At this time in our test program, several novel features were introduced. First, the conventional elliptic bolster springs were replaced with large diameter coil springs, vertical shock absorbers were introduced and levellizing bars employed. This experimental truck possessed many desirable features but at speeds over 90 m.p.h. it produced considerable vertical oscillation and therefore was unsatisfactory.

The same truck, with the elimination of the helical springs over the journal boxes and the introduction of an equalizer with conventional equalizing springs, was employed under passenger cars built at Milwaukee shops in 1938. It has proved satisfactory with the exception that the conventional wear of roller-bearing boxes, equalizers, spring hangers, etc., still prevails.

In 1939, an inboard truck was developed, equipped with a rotor brake. The generator for air-conditioning and train lighting was suspended from the truck frame and driven by a pneumatic rubber tire held against the tread of the wheel. While this truck was desirable from a weight standpoint and had good lateral stability, due to the increased spread of the bolster springs, it also had some weaknesses. The brake, at that time, was not sufficiently developed to justify its application; the roller-bearing arrangement was cumbersome and inaccessible, and most of the parts were not interchangeable with existing trucks. The generator drive, though interesting, was not very successful.

New coaches built in the year 1942 were equipped with trucks in which the conventional pedestals were eliminated and cast steel equalizers employed. The ends of the equalizers are formed to receive the roller-bearing boxes and the equalizer movement is spaced and controlled by rubber-cushioned guide members. This design eliminated all friction surfaces subject to wear, with the exception of the swing hangers.

End Results Sought

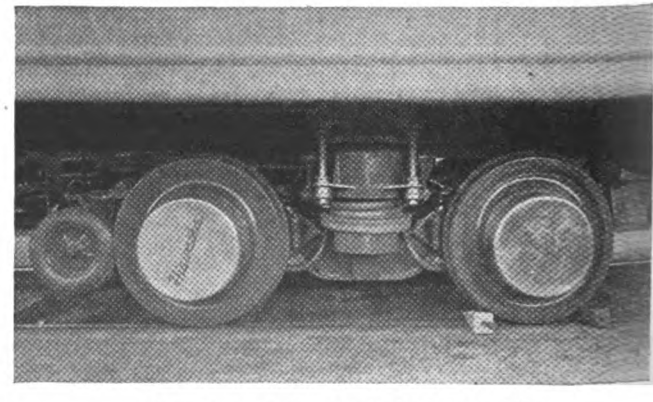
The foregoing is a brief outline of our search for an improved passenger truck design. Rather than go into a detailed description of each of the various trucks mentioned, the following is an outline of what we have endeavored to attain: (a) Safety, (b) improved riding qualities, (c) reduced weight, (d) lower noise level, and (e) elimination of friction surfaces.

Safety

In our developments and tests we have always set safety up as a first consideration and carefully observed the action of the trucks to detect any unusual behavior which would involve safety. We believe the truck developed for the 1942 cars is safer and more reliable than any truck we have heretofore produced because the equalizer also forms the pedestals and in a derailment the truck parts seem to hold together to a greater extent than in a conventional truck, helping to keep the car, with the aid of the center plate locking pin, on the right-of-way.

Improved Riding Qualities

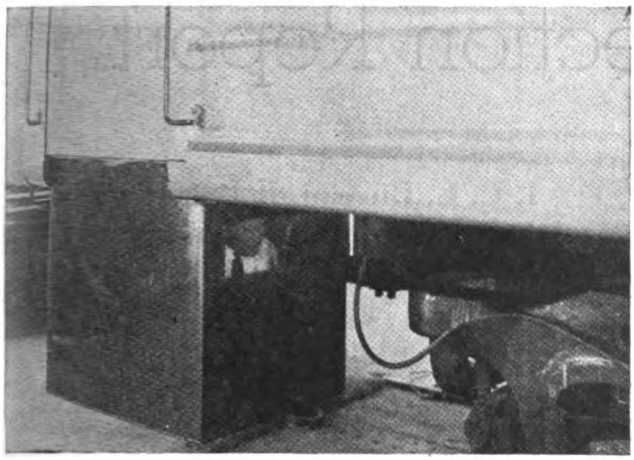
At the outset we endeavored to maintain the elliptical springs and improve the riding by increasing their deflection. As the ellipitical spring has a variable frictional resistance, depending upon the condition of the friction surfaces, and as this type of spring, under weather conditions we have to contend with, will often freeze into a solid block, we experimented with helical bolster springs. We



Inboard truck with rotor brake built in 1939

finally adopted one nest of helical springs at each end of the truck bolster, with a large outside diameter, in place of the elliptical springs. This new helical spring had a free height of 22½ in. and a solid height of 10⅛ in.

We also stubbornly insisted on absorbing the initial blows from the wheels by means of springs above or in the immediate vicinity of the journal box as that seemed to be the most logical and economical place for them.



Observation booth installed in place of the vestibule steps in the test car

After making many futile attempts with helical, semi-elliptical and volute springs and rubber cushions, we had to fall back on an equalized truck and locate helical springs at a distance from the journal. In experimenting with a large number of springs at various locations and with varied deflections, it appears that there is not much wrong with the location of the springs in a conventional passenger truck if physical conditions permit applying helical springs of suitable characteristics.

Helical springs used as standard for freight cars have an oscillating frequency of 216 cycles per minute and pass through their first critical cycle at a speed of about 45 m.p.h. for fully-loaded cars. In the latest 1942 Milwaukee-built passenger cars, the springs have an oscillating frequency of 88 and 59 cycles per minute for the equalizer and bolster springs, respectively. The truck goes through its last critical cycle, that we have been able to observe, at 26 m.p.h., which is far below the operating speed. We have been unable to discover any additional critical cycle above 26 m.p.h., although we have reached speeds up to 126 m.p.h. We do not know if we selected the best combination of springs but we do know that so far we have improved the riding in almost a direct ratio to the lowering of the oscillating frequencies of the springs. With soft springs, shock absorbers and levellizing bars are necessities.

Reduced Weight

The weights of four-wheel experimental trucks, without generators, varied from 12,870 lb. to 18,723 lb. With careful redesigning and the use of high-tensile steel and the liberal use of aluminum, we estimate that trucks can be built to weigh approximately 13,000 lb. or 26,000 lb. per car set.

Lower Noise Level

We have aimed to reduce the noise level inside the car and anyone who has tried to discover the source of noise will appreciate that this is a difficult problem. Assuming that most of the noise originates from the truck, we have probably taken some unusual precautions, and in so doing have obtained unusual and unexpected results. One of our first attempts, which we considered one of the vulnerable connections for transmitting noise from the truck to the car body, was the center plates. We, therefore, laid a 1-in. thick rubber cushion, bonded to a $\frac{3}{16}$-in. steel plate, in the truck bolster center plate; in addition, the periphery of the center plates was insulated with $\frac{3}{8}$-in. rubber which was bonded to sectional steel plates.

This arrangement was applied for test purposes in the year 1938 to a dormitory car in Chicago-to-Seattle service, and one of our engineers, at the time of the application, wrote his initials and the date in yellow chalk on the face of the steel plate. After this car had been in service 19 months, the engineer's initials were still legible, which proved that instead of the usual rotational movement between the steel surface, the 1-in. thick rubber had sufficient rotating flexibility to take ordinary curves. The car in question had been in the above mentioned service operating through the mountains where there are many 10-deg. curves. By freely employing rubber insulation between truck parts, metallic contact creating noise has been reduced. Continuing our search, we discovered that, although we had to the best of our ability insulated the truck from the car body, there is a fertile field for study of sources and transmission of air-borne noises to the inside of the car through tubular vertical end door posts in the frame of the body and the vestibule itself, which is outside the scope of this paper.

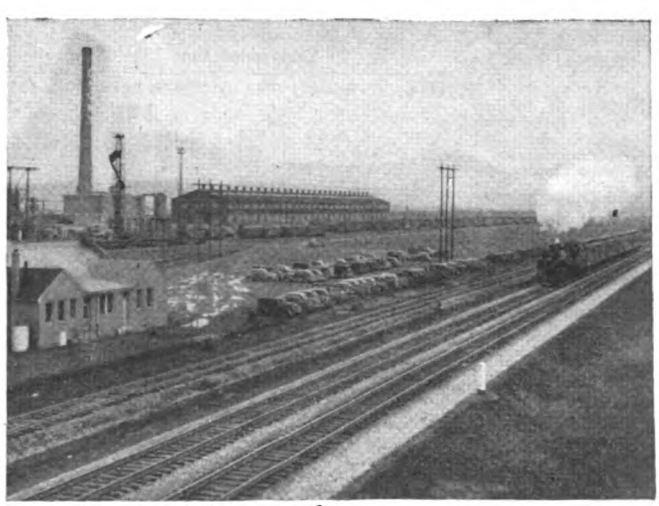
Elimination of Friction Surfaces

Friction creates wear and consumes power and both add to the expense of maintaining passenger-car trucks; its elimination means increased life and less adjustment of parts. By introducing the rubber between the truck and body center plate, as previously mentioned, all wear on those members was eliminated and we know that the life of the rubber is more than six years, having had some in service for that length of time. We have, by means of rubber-mounted guide members, eliminated the customary wear in bolsters, boxes and pedestals.

The swing hanger and swing-hanger pins are subject to severe wear and from experiments now being carried on, it appears that we can dispense with the swing hangers entirely and allow the large bolster spring to take care of the lateral motion between truck bolster and truck frame. At this time it seems wear of truck parts can be confined to wheels, roller bearings and brake parts. The life of the other parts would depend on the fatigue or durability of the materials employed.

In conclusion, acknowledgment is given to the General Steel Castings Corporation who have cooperated with us and have designed and furnished all cast steel parts used in several truck designs. Their engineers have also been of valuable assistance to us and have participated as observers in most of the road tests. The engineers of the Railway Steel Spring Division of the American Locomotive Company, the Monroe Auto Equipment Company and the United States Rubber Company have also given us valuable assistance.

* * *



The Chesapeake & Ohio car shop at Russell, Ky.

Locomotive Inspection Report

I. C. C. Bureau of Locomotive Inspection report again shows increase in defective locomotives; accidents and injuries also show increase

THE effect of wartime traffic loads on railroad motive power is again evident in the report of the Bureau of Locomotive Inspection for the year ended June 30, 1944, issued by John M. Hall, director. The number of accidents and the injuries resulting therefrom showed a decided increase although deaths as a result of such accidents decreased.

The Bureau's inspectors found defects on 11 per cent of the 117,334 locomotives inspected, and of these ordered 630 out of service.

In addition to the tabular data included in this abstract the report included a detailed analysis of defects in relation to the parts of a locomotive as well as by railroad. Summaries of accidents reported by road and arranged chronologically for the period, are also included in the report. The abstract follows:

Violent Explosions

All of the 19 explosions that occurred in the fiscal year, in which 12 persons were killed and 62 injured, were caused by overheating the crown sheets, due to low water. Five of these explosions, in which, with one exception, the boilers were torn from the running gears or frames, were particularly violent.

One of these accidents occurred while the locomotive was hauling a passenger train at an estimated speed of 70 m.p.h. The boiler was hurled about 700 ft. forward from the point of explosion; it turned over in flight and alighted on the track ahead of the train, then bounded and came to rest 900 ft. from the point of explosion, and 35 ft. south of the track. All wheels of the locomotive and tender, the first 10 cars, and the front truck of the eleventh car were derailed. The fifth and sixth cars came to rest in V-shape across the tracks, and the running gear and tender came to rest 1,300 ft. from the point of explosion. The firebox crown sheet with upper part of the door sheet and parts of both side sheets attached alighted, turned inside out, 400 ft. forward and 100 ft. to the right of the point of explosion. Three employees were killed and 9 mail clerks, 5 Pullman porters, and 15 dining-car employees were seriously injured.

In another explosion, which occurred while the locomotive was hauling a troop train at an estimated speed of 50 m.p.h., one employee was fatally injured and died approximately 30 hours after the accident, and two employees were seriously injured. The boiler was torn from the frame fastening but remained attached to the cylinders; the main frames were broken off at the rear of the cylinders, all wheels were derailed, and the boiler and running gear came to rest at the base of an embankment approximately 249 ft. west of the point of explosion. The first eight cars of the train were derailed. The first car of the train, an express car, was derailed to the right at a 45 deg. angle to the track, the second car, a standard Pullman, was derailed to the left and stopped practically parallel to the track ahead of all other wreckage. The third car, a tourist Pullman, came to rest on top of the express car which was demolished. The fourth car was derailed to the right at a 45 deg. angle, the fifth car leaned on the track fill parallel to the track, and the three following cars remained in upright positions.

Three employees were killed in another explosion which occurred while the locomotive was hauling a freight train at an estimated speed of 30 m.p.h.; the boiler alighted 340 ft. forward of the point of explosion with the rear end fouling the track; it was struck by the running gear which was then derailed.

In another accident where the boiler was torn from the running gear, in which one employee was killed and two employees injured, the locomotive, which had been hauling a freight train, was standing at a water tank. In its flight, the boiler destroyed the approach span of an overhead concrete highway bridge and came to rest on the slope of an embankment, 116 ft. from the point of explosion.

Two employees were seriously injured in another accident caused by explosion of the boiler of a locomotive which was hauling a freight train at an estimated speed of 15 m.p.h. This boiler was not torn from the running gear or frame but the force of the explosion lifted the back end of the locomotive and caused it to derail and overturn on its left side crosswise of the north-bound and south-bound tracks. Parts of the wreckage were found scattered over a radius of 500 ft.

Five employees were killed and 26 seriously injured in the remaining 14 accidents.

Occurrence of explosions caused by overheating of crown sheets due to low water, with consequent loss of life and serious injuries and damage to locomotives clearly points to the hazard brought about by any relaxation of the vigilance normally exercised in the maintenance of safe water level or in the promptness with which the fire is extinguished in the event a safe water level cannot be maintained. All employees whose duties in

Table I—Reports, Inspections and Defects Found

STEAM LOCOMOTIVES

	Year ended June 30—					
	1944	1943	1942	1941	1940	1939
Number of locomotives for which reports were filed	43,297	43,064	42,951	43,236	44,274	45,965
Number inspected	117,334	116,647	113,451	105,675	102,164	105,606
Number found defective	12,710	11,901	10,970	9,570	8,565	9,099
Percentage inspected found defective	11	10	10	9	8	9
Number ordered out of service	630	487	474	560	487	468
Number of defects found	56,617	51,350	44,928	37,691	32,677	33,490

LOCOMOTIVES OTHER THAN STEAM

	Year ended June 30—					
	1944	1943	1942	1941	1940	1939
Number of locomotive units for which reports were filed	5,139	4,351	3,957	3,389	2,987	2,716
Number inspected	7,711	6,847	6,728	5,558	4,974	4,581
Number found defective	378	298	358	319	298	260
Percentage inspected found defective	4.9	4.4	5	6	6	6
Number ordered out of service	9	6	12	21	16	14
Number of defects found	1,026	849	928	905	766	696

Table II—Accidents and Casualties Caused by the Failure of Parts or Appurtenances

STEAM LOCOMOTIVE, INCLUDING BOILER AND TENDER

	Year ended June 30—					
	1944	1943	1942	1941	1940	1939
Number of accidents	402	319	222	153	164	152
Number of persons killed	25	27	34	15	18	15
Number of persons injured	466	373	227	182	225	164

STEAM LOCOMOTIVE BOILERS

	Year ended June 30—					
	1944	1943	1942	1941	1915	1912
Number of accidents	141	129	81	43	424	856
Number of persons killed	17	25	30	12	13	91
Number of persons injured	194	173	83	64	467	1,005

LOCOMOTIVES OTHER THAN STEAM

	Year ended June 30—				
	1944	1943	1942	1941	1940
Number of accidents	17	15	9	11	7
Number of persons killed					
Number of persons injured	23	18	9	11	7

clude responsibility for the maintenance of safe water level should see that water glasses, including water-glass cocks and all connections are properly blown out and gage cocks tested, and that all are known to be in good working order before each trip. The water level shown in the water glasses should be closely observed at all times, and the glasses should be blown out sufficiently often during each trip and movement of the water in the glasses carefully noted at that time and thereafter to insure that the level in the glass moves up and down freely with the water level in the boiler which is subject to practically constant motion over a narrow range when the locomotive is working. It should be specially stressed that those observing the water level should always be guided by the lowest indication of any of the water-level indicating devices if there is any variation in the indications; in other words, the least favorable indication should be considered as the correct indication. Gage cocks should be tried frequently to check the level shown in the water glasses. If the water is below the line of sight in the water glass, emergency measures to protect the crown sheet from overheating should be taken at once; interpretation of a "flutter" of water from the bottom gauge cock as indicating safe water level in the boiler will in all probability result in disaster.

One thousand four hundred and four applications were filed for extensions of time for removal of flues, as provided in Rule 10. Investigations disclosed that in 46 of these cases the condition of the locomotives was such that extensions could not properly be granted. Sixteen were in such condition that the full extensions requested could not be authorized, but extensions for shorter periods of time were allowed. Fifty-nine extensions were granted after defects disclosed by our investigations were required to be repaired. Forty applications were canceled for various reasons. One thousand two hundred and forty-three applications were granted for the full period requested.

Mechanical Stokers

The Commission's Order No. 24049, dated March 18, 1939, established Rule 118 (c), the first paragraph of which requires that all coal-burning steam locomotives which weigh on driving wheels 160,000 lb. or more to be used in fast or heavy passenger service and all coal-burning steam locomotives which weigh on driving wheels 175,000 lb. or more to be used in fast or heavy freight service, built on or after April 15, 1939, be equipped with a suitable type of mechanical stoker and that such stokers be properly maintained.

The second paragraph of the rule required the filing by each railroad which operated coal-burning locomotives of the above weights, with the Director of the Bureau of Locomotive Inspection, lists as of April 15, 1939, of all hand-fired locomotives of the specified weights built prior to April 15, 1939, which would in the future be used in fast or heavy service, that mechanical stokers be applied in each 12-month period to not less than 20 per cent of the total number so listed, that all locomotives included in the lists be so equipped before April 15, 1944, and that such stokers be properly maintained.

The number of hand-fired locomotives built prior to April 15, 1939, reported by the railroads as of that date to be used in the future in services requiring the use of stoker-equipped locomotives was 2,171. The lists filed by the railroads were revised from time to time as traffic increased due to our preparedness efforts and our participation in the war, it being necessary to use in fast or heavy service all locomotives that could be made capable of such use because of inability to obtain a sufficient number of new and more modern locomotives satisfactorily to handle the greatly increased traffic.

These revisions in the lists, after adjustments due to conversion of some of the locomotives to oil burners, replacements with new stoker-equipped locomotives, assignments to other than fast or heavy service, and retirements, resulted in the application of stokers to 3,648 locomotives before expiration of the time limit on April 15, 1944. This number of locomotives upon which stokers were applied is 1,477 in excess of the number originally reported by the railroads required to be so equipped. Various extensions of time for equipment of 245 locomotives with stokers, all of which expired on or before December 31, 1944, were granted by the Commission pending shopping of the locomotives involved for classified repairs. Stoker applications to these locomotives are proceeding currently.

Man-power Saving

The equipment of these locomotives with mechanical stokers contributed materially to the ability of the railroads to handle war-time traffic successfully. The boilers of these locomotives are, in general, of such capacity that maximum power of the locomotives cannot be maintained over any considerable period of time by hand firing without hazard of physical exhaustion of the firemen. The installations of mechanical stokers resulted in making available the maximum power of the locomotives when needed and for long sustained periods of time, thus increasing their usefulness and ability in the movement of present-day traffic which is heavier, and for the most part, is moved with greater expedition than was ever heretofore thought possible.

A further assistance in our war effort brought about by the application of mechanical stokers to these locomotives is the saving in man-power and labor turnover, and reduction in lost working time, or absenteeism, of the firemen. The hand firing of these locomotives was an arduous task before present-day traffic conditions obtained and often resulted in the necessity for longer rest periods than are generally considered normal for persons engaged in that service; this condition would have been greatly accentuated, and many employees now regularly employed in the firing of stoker-equipped locomotives would have been compelled, for reasons of health, to leave that occupation if mechanical stokers had not been substituted for hand firing.

During the year 4.9 per cent of the locomotives inspected by our inspectors were found with defects or errors in inspection that should have been corrected before the locomotives were put into use; this represents an increase of 0.5 per cent compared with the results

Table III—Number of Steam Locomotives Reported, Inspected, Found Defective, and Ordered from Service

Parts defective, inoperative or missing, or in violation of rules	Year ended June 30— 1944	1943	1942	1941	1940	1939
Air compressors	1,146	968	829	684	567	518
Arch tubes	45	50	27	31	20	28
Ashpans and mechanism	93	71	80	67	37	67
Axles	15	15	2	5	3	2
Blow-off cocks	289	291	238	205	191	204
Boiler checks	533	503	393	313	288	279
Boiler shell	406	377	290	271	266	272
Brake equipment	2,914	2,661	2,382	1,945	1,506	1,577
Cabs, cab windows, and curtains	1,169	1,102	1,163	1,087	1,078	943
Cab aprons and decks	381	390	335	307	277	260
Cab cards	104	142	131	97	101	92
Coupling and uncoupling devices	65	66	70	74	53	60
Crossheads, guides, pistons, and piston rods	2,149	1,961	1,273	858	815	739
Crown bolts	105	66	75	97	54	47
Cylinders, saddles, and steam chests	2,133	1,395	1,514	1,332	1,320	1,232
Cylinder cocks and rigging	624	430	521	438	447	418
Domes and dome caps	189	196	112	94	78	90
Draft gear	576	599	651	620	508	450
Draw gear	515	469	369	347	306	360
Driving boxes, shoes, wedges, pedestals, and braces	2,026	2,053	1,743	1,348	1,243	1,330
Firebox sheets	347	303	255	224	191	238
Flues	274	215	178	150	147	165
Frames, tail pieces, and braces, locomotive	1,019	894	869	863	665	708
Frames, tender	126	86	86	83	78	71
Gages and gage fittings, air	158	191	193	183	132	155
Gages and gage fittings, steam	328	316	263	236	211	226
Gage cocks	532	584	497	373	400	361
Grate shakers and fire doors	539	492	491	430	273	252
Handholds	464	483	378	433	333	349
Injectors, inoperative	46	66	47	39	30	26
Injectors and connections	2,867	2,637	2,220	1,882	1,330	1,457
Inspections and tests not made as required	9,565	9,037	8,186	7,215	6,218	6,645
Lateral motion	898	700	498	357	313	243
Lights, cab and classification	243	184	131	50	49	50
Lights, headlight	268	184	218	190	180	177
Lubricators and shields	257	292	234	196	185	200
Mud rings	301	256	244	187	213	248
Packing nuts	746	669	689	508	418	408
Packing, piston rod and valve stem	879	724	738	675	660	739
Pilots and pilot beams	193	194	188	142	140	104
Plugs and studs	281	259	173	156	156	179
Reversing gear	454	452	411	387	320	317
Rods, main and side, crank pins, and collars	3,230	2,798	1,986	1,565	1,199	1,293
Safety valves	77	74	67	68	61	97
Sanders	609	642	738	490	415	432
Springs and spring rigging	4,625	3,583	3,349	2,597	2,174	2,340
Squirt hose	94	92	67	62	50	75
Stay bolts	400	367	272	239	227	181
Stay bolts, broken	232	247	274	198	271	258
Steam pipes	435	414	290	385	255	285
Steam valves	161	159	150	110	106	115
Steps	872	729	594	555	449	490
Tanks and tank valves	1,400	1,321	1,150	952	768	837
Telltale holes	69	78	79	59	95	58
Throttle and throttle rigging	948	887	786	688	647	638
Trucks, engine and trailing	1,155	1,020	833	636	598	628
Trucks, tender	928	900	786	773	705	665
Valve motion	1,021	998	779	580	506	554
Wash-out plugs	845	685	569	445	478	487
Train-control equipment	5	9	7	1	2	5
Water glasses, fittings, and shields	1,323	1,454	1,133	788	753	690
Wheels	759	728	664	536	554	466
Miscellaneous—Signal appliances, badge plates, brakes (hand)	1,167	1,142	970	785	564	610
Total number of defects	56,617	51,350	44,928	37,691	32,677	33,490
Locomotives reported	43,297	43,064	42,951	43,236	44,274	45,965
Locomotives inspected	117,334	116,647	113,451	105,675	102,164	105,606
Locomotives defective	12,710	11,901	10,970	9,570	8,565	9,099
Percentage of inspected found defective	11	10	10	9	8	9
Locomotives ordered out of service	630	487	474	560	487	468

obtained in the preceding year. Nine locomotives were ordered withheld from service by our inspectors because of the presence of defects that rendered the locomotives immediately unsafe; this represents an increase of three locomotives compared with the next preceding year.

Under Rule 54 of the Rules and Instructions for Inspection and Testing of Steam Locomotives, 583 specification cards and 5,996 alteration reports were filed, checked and analyzed. These reports are necessary in order to determine whether or not the boilers represented were so constructed or repaired as to render safe and proper service and whether the stresses were within the allowed limits. Corrective measures were taken with respect to numerous discrepancies found.

Under Rule 328 and 329 of the Rules and Instructions for Inspection and Testing of Locomotives Other Than Steam, 793 specifications and 28 alteration reports were filed for locomotive units and 117 specifications and 100 alteration reports were filed for boilers mounted on locomotives other than steam. These were checked and analyzed and corrective measures taken with respect to discrepancies found.

One formal appeal from a decision of an inspector, as provided in Section 6 of the law, was made during the year. Subsequent investigation resulted in the decision of the inspector being sustained.

This appeal was based on an order to withhold a locomotive from service which our inspector found in use with a crack in the hub of a main driving wheel. An earlier transverse crack had developed in the outer circumference of the hub between an intermediate and a

Table IV—Number of Locomotives Other Than Steam Reported, Inspected, Found Defective and Ordered from Service

Parts defective, inoperative or missing, or in violation of rules	Year ended June 30— 1944	1943	1942	1941	1940	1939
Air compressors	7	7	13	22	8	14
Axles, truck and driving	..	6	..	5	..	1
Batteries	1	2	1	6	1	1
Boilers	..	1	5	4	10	6
Brake equipment	85	62	86	69	50	50
Cabs and cab windows	40	33	27	45	22	36
Cab cards	21	17	20	24	13	18
Cab floors, aprons, and deck plates	54	31	10	14	17	13
Clutches	1	2	1	..	..	..
Controllers, relays, circuit breakers, magnet valves, and switch groups	14	9	12	7	16	13
Coupling and uncoupling devices	3	1	5	2	6	4
Current collecting apparatus	..	1	1	3	1	..
Draft gear	14	15	19	15	31	17
Draw gear	..	2	3	3	2	4
Driving boxes, shoes, and wedges	12	25	16	36	29	52
Frames or frame braces	12	7	5	1	12	9
Fuel system	33	32	81	62	51	35
Gages or fittings, air	6	3	8	3	1	6
Gages or fittings, steam	2	1	..	..	2	..
Gears and pinions	1	4	4	2	1	3
Handholds	6	19	14	12	6	8
Inspections and tests not made as required	278	223	274	243	207	185
Insulation and safety devices	8	4	3	4	2	4
Internal-combustion engine defects, parts and appurtenances	86	50	62	54	35	38
Jack shafts	8	2	1	3	7	6
Jumpers and cable connectors	2	3	1	..	..	2
Lateral motion, wheels	9	10	..	4	5	3
Lights, cab and classification	1	1	5	2	1	3
Lights, headlight	2	2	1	1	3	4
Meters, volt and ampere	2	3	2	..	4	2
Motors and generators	14	14	16	16	12	19
Pilots and pilot beams	2	4	10	12	10	5
Quills	18	9	6	..	4	2
Rods, main, side, and drive shafts	10	..	2	4	2	2
Sanders	59	41	57	56	34	28
Springs and spring rigging, driving and truck	44	18	35	58	50	16
Steam pipes	3	1	..	1	4	..
Steps, footboards, etc.	25	25	21	35	22	18
Switches, hand-operated, and fuses	2	2	2	2	3	5
Transformers, resistors, and rheostats	..	3	3	3	1	1
Trucks	47	22	28	30	43	33
Water tanks	1	4	1	1	..	1
Water glasses, fittings, and shields	4	2	5	1	1	1
Warning signal appliances	2	3	3	4	..	1
Wheels	74	107	43	28	22	16
Miscellaneous	13	16	14	8	15	10
Total number of defects	1,026	849	926	905	766	694
Locomotive units reported	5,139	4,351	3,957	3,389	2,987	2,710
Locomotive units inspected	7,711	6,847	6,728	5,558	4,974	4,581
Locomotive units defective	378	298	358	319	298	266
Percentage inspected found defective	4.9	4.4	5	6	6	6
Locomotive units ordered out of service	9	6	12	21	16	14

short-length spoke, and fusion welding had been applied in an attempt to repair this crack. Our inspector found a crack at the edge of this welding which crack had extended to the outer face of the hub and into the hub 4 in. toward the axle fit. When reexamined following the appeal, the presence of the crack was clearly evident without visual aid. It was stated in the appeal that a Magnaflux test of the wheel center had been made and that no crack was indicated by that test; after our reexamination the railroad officer who made the appeal advised that he had been misinformed as to the application of the Magnaflux test.

Recommendations

In accordance with the provisions of Section 7 of the Locomotive Inspection Act, the following recommendations, with reasons therefor, are made for the betterment of the service:

1—All steam locomotives should be equipped with a brake-pipe valve, similar to the conductor's valve used in passenger train cars and caboose cars, at the rear of the cab or the front end of the tender to enable the brakes to be applied in the event the enginemen are, from any cause, prevented from applying the brakes in the usual manner.

Numerous accidents have occurred where, due to sudden failure of steam pipes or other causes, the cabs were immediately filled with steam and the occupants were forced out of the cabs without opportunity to close the throttle or to apply the brakes in the usual manner. Practically the only way that a train can be stopped in instances of this kind is for the engineman or fireman to climb out of or over the cab and make way to the front end and open the front-end brake-pipe angle cock if it is accessible.

2—All road steam locomotives should be equipped with means whereby the height or quantity of water in the tender feed-water tank may be ascertained from the cab or tender deck of the locomotive.

In the interest of expeditious movement of trains it often becomes necessary while proceeding on the line of road for the locomotive crew to have knowledge of the height or quantity of water remaining in the tender tank. The common practice in these instances is for the fireman to make his way back over the tender coal space, or fuel oil tank, to the filling hole on the rear of tender, open the cover of the filling hole, and measure the water height by whatever means that may be available. While performing this service, many slips and falls resulting in serious injuries have occurred due to the swaying of the tender while the train is in rapid motion, and weather conditions which render it difficult to maintain safe footing. The results of accidents of the nature herein described are not recorded in the accident statistics of the Bureau of Locomotive Inspection unless due primarily to some defective condition of the locomotive; however, the unnecessary hazard in proceeding over the tender to the filling hole to measure the water in the tender while the train is in motion at normal speeds is apparent.

The first recommendation was made in a previous annual report. Some of the railroads have recognized the value of the additional air-brake valve and have applied such a valve to a limited number of their locomotives. Likewise, some of the railroads have recognized the value of means to ascertain the quantity of water in the feed-water tank from the cab or tender deck. However, compliance with recommendations 1 and 2 is by no means generally widespread, and installations are not progressing to the extent that could be desired to obtain the maximum degree of safety.

In this low-water explosion the boiler was thrown 116 ft.—One employee was killed and two seriously injured

EDITORIALS

Hot Boxes a Perennial Problem

It is practically impossible to eliminate hot boxes in railway equipment, especially freight cars, but, admitting freely the present handicaps of severe winter weather in many parts of the country, difficulty in retaining an adequate force of experienced car men, lack of suitable packing materials, etc., much more can and should be done to keep the number of hot boxes down to a point where they will have a substantially less adverse effect on railway operation. Hot boxes cannot be *eliminated*, but they can be *minimized*.

No longer ago than last October, the A.A.R. Mechanical Division, anticipating what probably lay in store in the way of equipment delays due to the development of hot boxes under adverse winter conditions, made a study of journal-box inspection and lubrication practices then being followed by railroads and private car lines and found them deficient in many particulars. Some of the more predominant irregularities included the following: Packing in storage not properly saturated; improper waste reclamation; excess amount of free oil used during periodic attention; interior of journal boxes not properly cleaned prior to repacking; improper reclamation of journal bearings, resulting in loose lining and other irregularities; missing or defective dust-guard plugs not renewed during periodic attention or when wheels are exchanged; loading of cars where journal boxes are overdue for periodic attention; improper storage of journal bearings, resulting in injury to bearing surface; use of packing irons with too short blades; flat condition of wedges not determined during periodic inspection; missing, loosely fitting or otherwise defective journal-box lids; journal bearings worn out; packing too high, or contaminated with water, dirt, sand, gravel, wood, rags, rust and other foreign matter; packing dry, not evenly distributed, rolled and up against the journal bearings or worked forward and up against the journal-box lids; waste grabs under journal bearings on cars lined up in trains O.K.'d and ready for departure.

The A.A.R. issued a circular letter calling attention to these unsatisfactory conditions and irregularities and suggesting that each railroad and private car owner investigate practices at its own shops and repair tracks and take action to assure compliance with present approved rules instead of waiting for an official investigation and report by the A.A.R. Mechanical Inspection Department. The record of hot boxes developing in recent months proves that less than the desired amount of work has been done along this line in raising journal-box inspection, lubrication and maintenance standards.

Hot boxes in passenger car service have constituted a real problem on many roads this winter. With excessively low temperatures, it is impossible for coach yard forces to function with their usual efficiency in inspecting and servicing journals. Cold journals, in starting, frequently cause the packing to roll up and work under the brasses. And perhaps worst of all, snow and moisture get into the journal boxes through poorly-fitting covers and dust-guards, freezing and breaking down the lubricating properties of the packing. There is only one solution to this problem and that is to get busy, in spite of all handicaps, and inspect all journal boxes on incoming trains, repacking those which show evidence of moisture or other undesirable conditions, applying a small amount of cut-back oil where necessary to prevent waste from rolling and checking all boxes again before trains leave.

At one large passenger terminal in Chicago where these practices were put into effect in December, the number of journal boxes repacked jumped to 750 a day and several hundred journal-box covers a day were refitted and applied in an effort to keep out snow and water. This was a really big and tough job, under the conditions, for the car department force involved, but the gratifying result, was a reduction in passenger-car hot boxes on that road from 7 or 8 a day to about one a day or less. In spite of strenuous efforts, it seemed impossible to cut out that last hot box, which simply bears out the statement earlier in this editorial that hot boxes can be minimized but hardly eliminated.

Jack-Handle Days

According to the best estimates of time-study men on one of our major railroad systems, two 50-ton air-operated jacks installed at an average freight-car repair point today will have paid for themselves by savings in labor costs alone within 15 months. Even more important are the man-hours saved for use on other work and the increased speed of car release from repair points. Experience has shown that about 800 hours of mechanics' or helpers' time has been saved through such an installation during the course of a single year. At an exceptionally busy shop point such an installation made in 1937, was paid for within the first four months after the jacks were delivered.

Various committees of the Car Department Officers Association and other groups have urged consistently that more attention be paid in the expenditure of mechanical department funds to the needs of car repair points. Whether the men on the locomotive side have been more articulate in expressing their needs isn't clear but generally it appears that a new shaper for the backshop or a lathe for an enginehouse is more likely to be approved than two jacks for the car yard. Their relative cost is small, the rate of amortization on the

investment high but at all too many points the jack handle rather than the air-line lifts cars.

What is true of car jacks is true of many other items of equipment in use at car repair points. A thorough study on any system of the possibilities of employing modern tools and devices would enable car department officers to approach management intelligently with requests for appropriations. The accumulated labor cost and car-release delay time represented by jack-handle days should convince even a stubborn management in times much harder financially than the present.

Notes on Lighting

In the course of developing the nation's industry for war, many huge war plants have been built which are spectacular for their size, the speed with which they have been placed in operation, the great number of people they employ, etc. Frequently they are equipped with lighting installations which in themselves are spectacular for the large areas lighted and for high values of lighting intensity. They make most railroad shops appear dingy by comparison, but they should not for this reason alone be held up as an example of what railroads should do. Any engineer can install a large number of fixtures and obtain high intensities if his cost accounting is not scrutinized too closely. To get an installation which meets the needs of a specific requirement at a justifiable cost requires real engineering.

More or less typical railroad lighting is usually farther from good practice than that in hastily constructed war plants. Railroad lighting stemmed originally from the smoky oil torch, which even now finds favor among many enginehouse workers. In one location portable extension cords were connected permanently in an enginehouse and instructions to use them issued from headquarters, but the oil torches would reappear as soon as the headquarters representative was gone. Persistence in the use of oil torches may be partly tradition, but the fact that the practice continues so tenaciously suggests that some of the newer methods are not enough better to assure displacement of the torches. Much experimenting is being done in this field and the use of fluorescent lamps offers considerable promise.

Among lighting engineers it is quite generally accepted that good lighting in a shop consists of uniform general illumination, supplemented at machine tools, benches, etc., by local lighting units which increase the intensity of the lighting on the work being done. Glare is of course to be avoided as are also any brightness contrasts in excess of ten to one; that is, the work should not reflect more than ten times as much light as the background.

Good general illumination in a machine shop may constitute bad lighting. Suppose for example, the illumination on the horizontal plane is 20 footcandles. It may, however, be no more than ten on the vertical plane. Then when the operator, who is working on a vertical surface, stands up to his machine, his shadow may reduce it to two or three. If the reflection factor of the work is perhaps half that of the background, the operator is then looking toward a background that is twenty times as bright as the thing he is trying to see. Conversely, if only local lighting is used, the work may be so much brighter than the background that his eyes tire quickly.

Priorities on material have made it difficult for the railroads to do much about improving of lighting systems, and in many railroad locations, depreciation rates of such equipment are high. By the time the material situation becomes easier, the railroads will have much lighting replacement work to do and it is expected that they will take full advantage of available knowledge of what constitutes good lighting and also of the many new light sources, light controls and wiring materials which have been developed since the railroads have had full opportunity to make lighting installations.

Boiler Explosions — Must We Have Them?

During the year ended June 30, 1944, according to the report of the Bureau of Locomotive Inspection, I. C. C., there were 19 locomotive boiler explosions in which 12 persons were killed and 62 injured. All of these explosions were due to low water and overheated crown sheets. This is a record which the railroads have no reason to be proud of and in viewing these statistics it matters not so much whether there were fewer, or less, explosions than in some previous period, but that there were *any* at all. It may startle some people to make the blunt statement that there is no excuse for a boiler explosion but such is the case and in making such a statement we recognize that we are ignoring their basic cause—human carelessness and poor judgment.

In discussing boiler explosions one is faced with the necessity of repeating again and again arguments that have been used as long as there have been steam locomotive boilers so that it is not possible to present some new approach to the problem in the light of recent experience. These accidents, except for that one case in a million, are the result of man-failures and, in all fairness to the men who operate locomotives, it may be well to say right at the outset that such man failures are not always chargeable to the men in the cab.

We have had enough experience in the design and construction of locomotive boilers that it is reasonably safe to say that any boiler constructed in accordance with I. C. C. requirements is a safe boiler, if . . . (1) the safety and protective devices which have been installed on it are maintained, at all times, in an operative condition; (2) these devices are inspected both by enginehouse inspectors, the engine handlers and the engine crews to make sure that they are functioning properly before a locomotive ever leaves a terminal and (3) the

water level indications are constantly checked by the engine crew and water supplied to the boiler to maintain a proper level in accordance with its requirements. These things having been done there is rarely ever an excuse for loss of life, an injury or the destruction of property as a result of a boiler explosion. Why, then, do we continue to have them?

There is one thing that the I. C. C. Bureau of Locomotive Inspection report does not show and that is the number of near-explosions, these unrecorded cases where the initiative, the good judgment and the quick action on the part of an engine crew have saved life and property by dumping a fire when it became evident that there was no chance of maintaining the proper water level in the boiler. Possibly these are the incidents about which greater publicity should be given, for behind them are the controlling factors that operate to prevent boiler accidents. If every railroad management could impress indelibly on the mind of every employee connected with locomotive boiler operation the simple fact that there are times and circumstances when there is only one thing to do—to dump the fire—we would see an immediate reduction of boiler accidents. Management must, however, carry on a constant campaign of education and discipline; education in the fact that safety of operation and the protection of life and property are always more important than the maintenance of a schedule; discipline in boiler maintenance, inspections and those details of watchfulness and functioning on the part of every employee whose job it is to *watch the water level.* And when that crucial moment comes when, through whatever cause, the water level cannot be maintained, management must also have made it clear that there need be no hesitation or concern about what some one will think—just dump the fire.

Present Wheel Shop Machinery Inadequate

Some modern machine tools and shop equipment have been installed in railway wheel shops in recent years, but not enough to have any great effect on the total machine inventory as regards its state of being to a large extent old, worn out and obsolete. Additional testimony to the accuracy of this statement was afforded at the December 11 meeting of the Car Foremen's Association of Chicago when the principal paper, "Wheels for Post-War Railroad Service" was presented by C. T. Ripley, chief engineer, Wrought Steel Wheel Industry, and the entire subject of wheel performance and maintenance was gone into quite thoroughly.

In introducing his subject, Mr. Ripley pointed out that the total annual cost for all types of locomotive, passenger and freight car wheels on one large railway system was $2,110,000 and that this figure, if applied proportionately to the total car and locomotive ownership of all railroads, exclusive of cars of private ownership, would amount to approximately $60,000,000 a year. This amount is a sizable percentage of the total cost of equipment maintenance on American railroads and hence constitutes an item which should be constantly checked and rechecked from every angle of wheel purchase, use and maintenance, with a view to effecting maximum practicable economies. The statement was made during the course of the meeting, and not challenged, that improved wheel practices, particularly as regards maintenance, would make it feasible to reduce total wheel costs to the railroads at least 20 per cent or $12,000,000 a year.

Here, then, is the incentive for a re-examination of railway wheel shop machinery and practices which need further substantial improvement in spite of all of the efforts already made along this line, both by individual railroads and the Association of American Railroads, Mechanical Division. Unsatisfactory conditions, all too commonly found, include out-of-round wheels, taper wheel seats, mismated wheels, poorly finished journals, etc. Some old axle lathes cannot machine either wheed seats or journals accurately. Boring mills sometimes cannot be kept in condition to bore wheels central regardless of constant checking. Mr. Ripley stated that on some of the older wheel lathes, wheels are turned as much as .04 in. eccentric and on the average wheel lathe .02 in. He advocated the use of modern grinding machines which can hold this eccentricity to .005 in., with resultant improved riding, less wheel sliding, less wear and breakage of truck parts and fewer hot boxes.

Not only should wheels be accurately round and concentric with the journals when applied under freight as well as passenger equipment, but this condition ought to be maintained in service, and modern wheel-grinding machines are an important aid in this desirable objective. It may also be said in favor of the grinders that they conserve a large amount of tread-wear metal by making it unnecessary to cut under work-hardened wheel treads, in order to hold a chip and avoid breaking wheel-lathe tools. Wheels with flat spots up to 2 in. long, for example, can be reconditioned by grinding off just enough metal to give a true circular tread, whereas a wheel-lathe cut generally has to be at least ⅛ in. deeper.

Another machine which may in a short time receive consideration for installation in car wheel shops is a balancing machine for mounted passenger-car wheels. Such machines have already been developed and experiments are now being conducted, primarily to find a satisfactory method of correcting any conditions of static or dynamic unbalance which may be uncovered. It seems clear that for the high speeds of to-day and possible super speeds in the post-war period, passenger-car wheels may have to be balanced to assure the necessary smoothness and quietness of car operation.

In these days of arduous and high-pressure rail transportation, railroad men are confronted with many problems, not the least of which is the improvement of wheel performance, especially as influenced by wheel-shop machinery and practices.

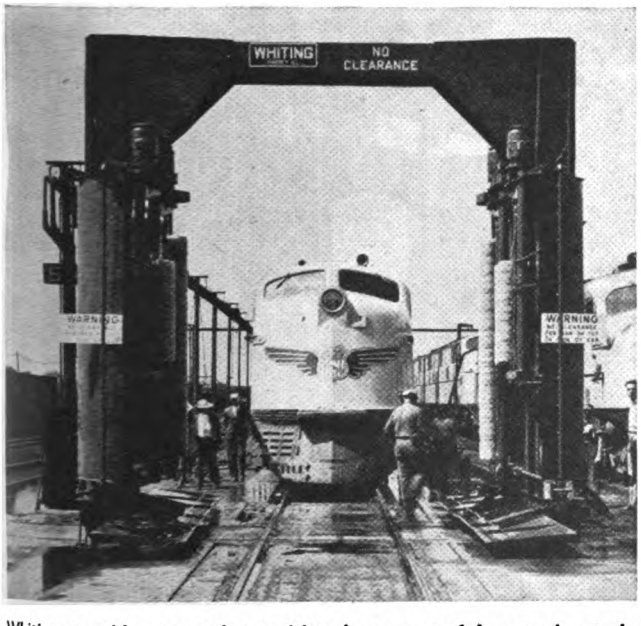
With the Car Foremen and Inspectors

C. & N. W. Installs Portable Car Washer

The exterior cleaning of passenger train cars is an arduous job under the best of conditions and especially so at present, owing to difficulty in maintaining an adequate labor force. To meet the emergency presented by high car-cleansing costs, shortage of labor and the necessity of quick turn-around time for the large number of streamline trains operated into Chicago over the lines of the Chicago & North Western, this road has installed a portable car washing machine at its Diesel streamliner servicing yard which is producing unusually good results.

This machine, made by the Whiting Corporation, Harvey, Ill., is mounted on small wheels on a cross-track so that it can be easily rolled into position at any one of four active tracks for washing streamline coaches and Diesel locomotives as the trains are backed on to the servicing tracks. On the basis of experience with this car washer since it was installed last August, normally washing an average of four trains, or 60 cars, a day, including 12 Diesel-electric locomotive units, it is estimated that the machine will more than pay for itself in the first year of operation.

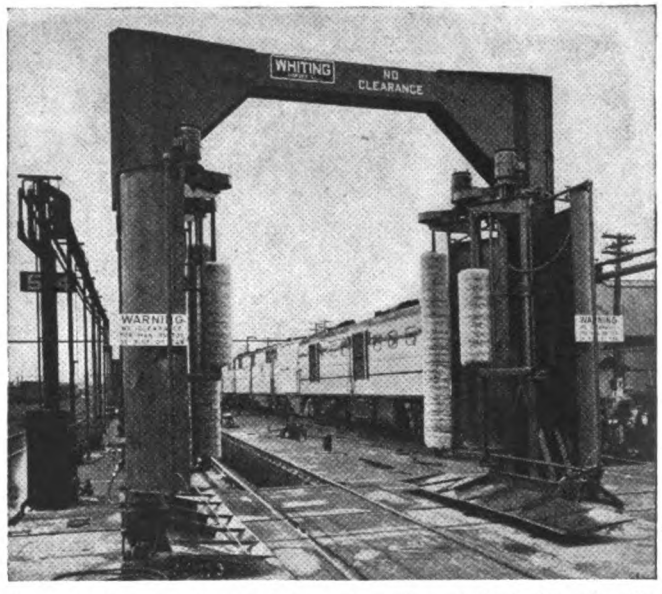
Referring to the illustrations, the general construction



Whiting portable car washer positioned over one of four tracks at the C. & N. W. Diesel-train servicing yard, Chicago—One train has just backed through the washer

of the portable car washer will be apparent. It consists of two substantial vertical steel members, tied together at the top by a sturdy cross member, well braced with gussets. The bottom ends of the columns are equipped with four flanged wheels for movement across the servicing tracks by means of a hand racking mechanism. The machine is clamped and positioned by four adjustable clamps hooked to ground rings, and four liftable pins engaging suitably located holes in the cross track. The machine is designed to be readily moved by one man and rigidly held when clamped.

This portable car washer, as installed on the North Western, is designed for one-way washing only, as all cars are washed while passing in one direction to the layover tracks. Each side of the washer carries one long 15-in. by 9-ft. brush which operates at a speed



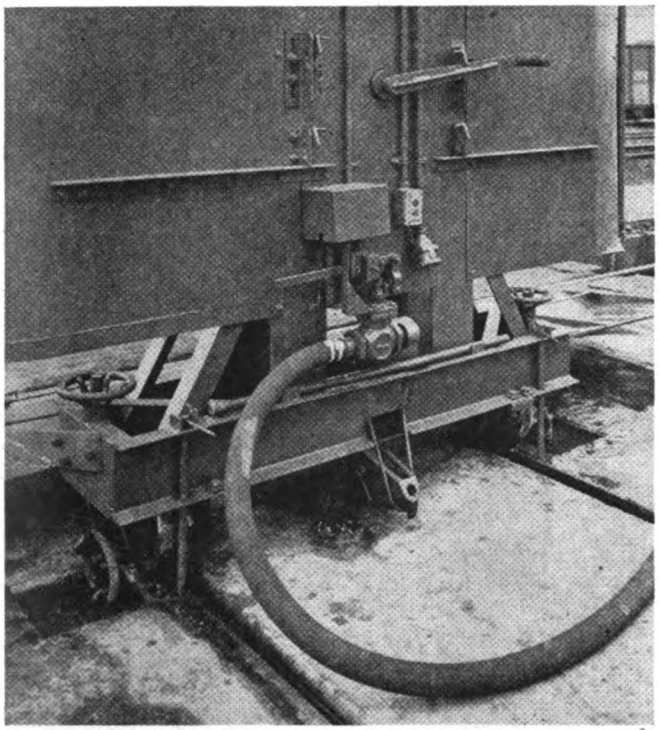
The portable car washer ready for a streamliner to back through under its own power

of about 240 r.p.m. by V-belt drive from a 3-hp. electric motor and is used to wash a car side from the edge of the roof down to the bottom of the side sheets. A self-alining feature enables this brush to adjust its position to the tilt of the car bodies. The shorter 15-in. by 3-ft. 10-in. brush, also operates at 240 r.p.m., but driven by V-belt connection from a 2-hp. electric motor, is positioned so as to wash the windows which are practically flush with the car sides in modern streamline equipment. These brushes consist of fibres suitably secured to wood cores and applied in staggered half sections which are bolted together around a slotted drive shaft. The brushes are thus positively prevented from turning on the shafts and there are no uniform horizontal breaks or lines between individual brush sections to leave marks on the car sides.

There is one water-spray pipe back of each brush to keep it well soaked and, in addition, the entrance and exit end on each side of the car washer carries a full-length vertical water pipe with eleven ½-in. nozzles, evenly spaced about 10 in. apart and directed at right angles against the car side which thus receives a copious water bath both before and after passing the brushes. Drain pans and splash plates are applied to deflect the falling water into sewer openings located directly under the car washer.

Reference to the illustrations will show that the brushes

are mounted on swinging arms and may be held against the car sides at constant predetermined pressure by means of suitable counterweights. When not in use, the brushes are swung back out of the way of any cars which may be passing through. Brush arm movements to



The anchoring mechanism, hand-ratchet device, water and electric connections and brush control lever

"operative" and "inoperative" positions are controlled by a 30-in. hand lever located on the back of the structure at each side of the car washer. Water is supplied through a single 2-in. hose connection to the car washer and it is extremely important to have an adequate supply of water, preferably at a pressure of about 40 lb. Electric connections to the brush-operating motors are supplied, with push-button control from the same side of the machine to which water is supplied.

How the Portable Car Washer Is Used

After streamline trains arrive at the C. & N. W. passenger station and are unloaded, all vestibule doors are carefully closed and the same engine crew backs the train a short distance west to the Chicago shops where it is slowly pushed through the portable car washing machine, at a rate of about 80 ft. a min., and on to the servicing tracks where all other necessary work is done during the limited layover time. (When again ready for service, the train is backed on through the servicing yard to a large Y, headed west on the main line and backed into the Chicago passenger station for reloading.)

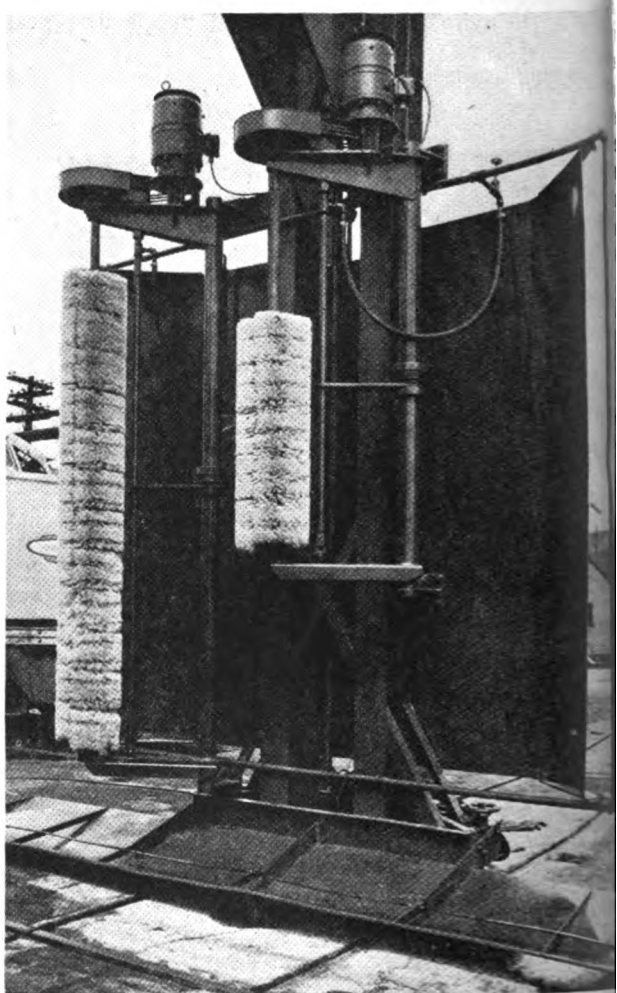
With adequate water pressure and volume and brushes revolving at the specified speed, cars passing through the washer will be cleaned at least as thoroughly as by hand and, of course, with much less manual labor. In North Western experience, it has been found desirable to hand wipe the windows afterwards in order to avoid streaks, and the front ends of the Diesel locomotives and the rear ends of the observation cars have to be hand cleaned. Car roofs are not washed, because drippings from the roof would run down after rinsing and have a tendency to streak the car sides. Another limitation of any car washer operated out of doors is that it cannot be successfully used in freezing temperatures.

How Exceptionally Dirty Cars Are Cleaned

It is understood that the car washing operations described thus far comprise what is called "light cleaning" and utilize water, only, in the car washing machine. For those cars requiring "heavy cleaning," it is necessary to apply a light and preferably uniform spray of oxalic acid or some commercial cleaner, thoroughly distributed over the car sides and allowed just enough time to neutralize itself before being brushed and rinsed off in the car washing machine.

For this purpose, the North Western has constructed two vertical stand pipes each equipped with three $\frac{5}{64}$-in. spray nozzles and located on either side of the lead track about 100 ft. ahead of the car-washing machine at the servicing tracks.

The cleaning solution, mixed in one of the adjoining car shop buildings, is contained in two 80-gal. tanks mounted on wheels and supplied with air which forces the cleaner out of the standpipe nozzles in fan-like sprays covering the car sides from the top of the letter boards to the bottom edges of the skirt sheets. The North Western found that if cars are then moved down the track and through the car washing machine, the leading water spray will have the effect of washing off a considerable amount of the cleaning solution before it has a chance to be worked in by the brush. In washing cars, therefore, which require the use of a cleaning solution, the



The brush support and driving mechanism, spray pipes and drip pan

lead water sprays on the car washer are turned off; the brushes thoroughly rub the cleaner on the car sides; and the final spray rinses the cleaner off.

Several precautions need to be observed, aside from maintenance of proper brush speed, water pressure and volume. In the first place, the location of the cleaning solution sprays sufficiently in advance of the car washer is of fundamental importance, also assurance that the cleaner does not remain too long on the highly-finished car surfaces; car speed past the brushes must not be too fast and the North Western finds that one car a minute, or roughly 80 ft. a minute, is about right for the desired results; all sprays and brush action must be controlled so as to avoid getting water on the car roofs from which it will subsequently drop and streak the car sides; in the case of cars washed with the cleaning solution, all of this solution must be thoroughly scrubbed and rinsed from the car sides before they are allowed to dry, otherwise the exterior finish will be damaged.

To make doubly sure of the latter objective, it is proposed to increase the number of nozzles on the exit spray pipe in the present installation and direct them both ahead and back of the perpendicular so as to flush the car sides even more thoroughly than is now the case.

This portable car washer installation on the North Western is the first of its kind and hence somewhat experimental in character. On the basis of experience, minor changes and improvements may be expected. It has been recommended, for example, that consideration be given to installing an additional long brush on either side of the machine to assure a still more thorough cleaning job in less time; that an electric pump be installed, especially in cases where there is any tendency for the water pressure at delivery nozzles to drop below 40 lb.; that wheels of larger diameter be installed to facilitate moving the washer over the cross tracks; and that refillable metal brush cores be substituted for the present wooden ones in order to permit increasing the brush speed to 370 r.p.m. and avoid the warping and breakage tendency of wood-core brushes.

Savings effected with the present portable car washer are large, however, in spite of being based on the relatively light operation of washing an average of 60 cars a day. The capacity of the machine is much higher than this and hence it is adapted to make proportionately increased savings if and when additional service tracks are installed at the Chicago Diesel train yard and more cars are available for and require washing.

More Rigid Car Inspection Needed

In a circular letter, dated January 15, V. R. Hawthorne, executive vice-chairman of the A.A.R. Mechanical Division calls attention to reports being received of an increasing number of defective and broken truck side frames, particularly of the older types. Unless the defective conditions are detected in inspection and corrected, failures may occur enroute and result in derailments or wrecks. The older-type side frames must be maintained for the duration of the war emergency. Realizing this, the letter stresses the need for special efforts to inspect these frames, also defective bolsters, wheels, couplers, brake beams, etc., which constitute a definite hazard to operation. It is requested in the letter that all railroads and car owners take necessary action to insure a most rigid inspection of trucks, wheels and couplers at all interchange points and when cars are on repair tracks, everything possible being done to detect and correct defective condition of these parts to avoid failures in service.

C. & N. W. Tries New Journal-Box Cover Shield

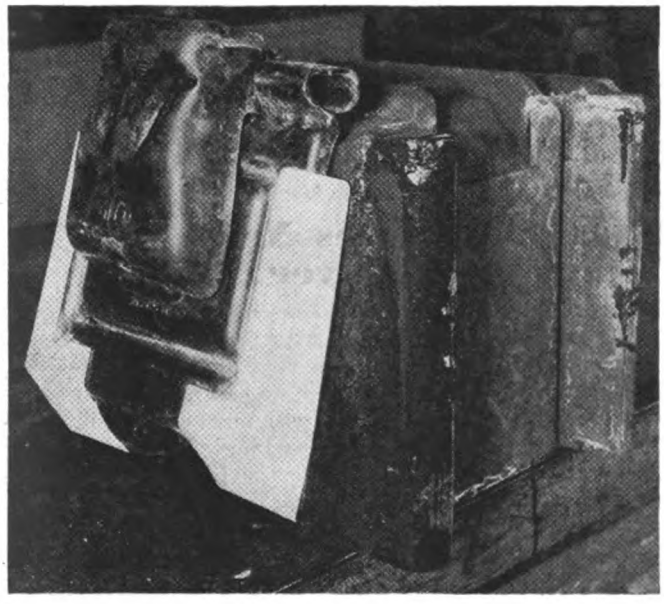
One of the most serious problems confronting the railroads, particularly this winter as a result of heavy snow falls throughout the country, is combating hot boxes on passenger trains. It has been necessary to resort to unusual tactics, including the assignment of additional forces in coach yards for the repacking of journal boxes as the result of water-saturated packing. In order to reduce the entry of snow and road dirt in journal boxes,

The shield shown with the lid open

a journal-box cover shield has been devised, as shown in the illustrations, by G. R. Anderson, assistant superintendent car department, Chicago & North Western, and is now being generally applied to passenger train cars on this road.

These shields, not patented, are made of No. 16 gage galvanized sheet steel, in two parts or sections, one right and one left, each being trimmed to size from a flat sheet, veed out at one corner and having two sides bent or flanged so as to bring the edges of the vee together where they are held by tack welding. Two shield sections are then applied by spot welding, one on each side of the journal box cover in such a way that one flange covers each side joint and the lips on the bottom of the shield cover the bottom joint.

In the main, this journal-box cover shield serves as a wind deflector to keep air current caused by high-speed



Journal-box cover shield developed on the Chicago & North Western

operation from blowing directly at on into the joints between the cover and the journal box. The Chicago & North Western has found that, with these shields attached, the intake of snow and foreign matter at the front end of journal boxes has been greatly reduced which tends to prevent the development of hot boxes from this cause and makes it unnecessary to repack journal boxes as frequently as in the past when, under adverse winter conditions, 500 to 800 boxes had to be repacked every day at some large coach yards.

Air Brake Questions and Answers

HSC High-Speed Brake Equipment for Passenger Cars and A and B Diesel Locomotive Units*

267—Q.—Describe further, the various parts of the independent brake valve and their functions. A.—The brake application is obtained by moving the handle to the right which increases the cam pressure on dog *72* and pusher *68*. The balance levers are attached to pusher *68* with roller *69* pivoted on exhaust valve *65*. The lower end of the balance lever pivots on inlet valve *50* through push rod *70*. The balance levers control the self-lapping function of the brake valve, as later explained. The exhaust valve seat is located in piston *59* and is connected by a series of holes to the spring cavity which is open to the brake valve exhaust. The interior chamber of the brake valve is connected to the independent application and release pipe. This connection is controlled by the cam through the dog, to hold application valve unseated in all positions of the brake valve handle except locking position. The brake valve handle is hinged by a cam roller and is held upward by a spring. Independent release is obtained by depressing the brake valve handle on a ball which operates the release check volves. The lower spring normally holds the lower check valve seated, closing off the main reservoir supply, and the upper check valve unseated, opening the actuating pipe to the atmosphere. When the handle is depressed on the bail, the plunger seats the upper valve and opens the lower valve, permitting the main reservoir air to flow to the actuating pipe. The locking position consists of a slot in the handle guard at the extreme left. To place the handle in this position, depress the handle and move it to the left into the slot, which locks the handle down. The plunger seats the upper valve and unseats the lower valve, holding the brake released. Also in this position the handle cam raises the dog and seats the application valve, closing the independent application and release pipe. Controlled emergency valve is held seated by a spring in all handle positions except full application, in which position a cam on the handle shaft engages the valve stem and unseats the valve.

268.—Q.—During initial charging, what must be done? A.—Either the MS-40 brake valve handle or the foot valve pedal must be held down.

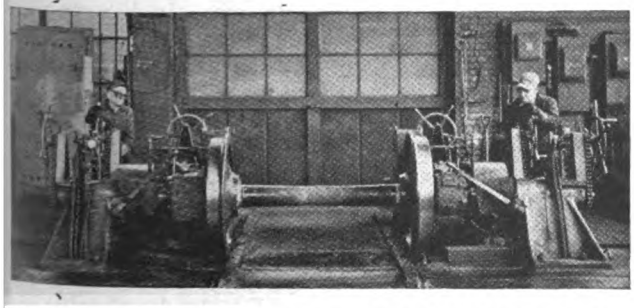
269—Q.—Describe the initial charging operation on locomotives. A.—With air compressors cut in and operating, air flows to the first main reservoir of each unit, thence through the connecting pipe and check valve to the second main reservoir. A branch from the reservoir connecting pipe is connected between units and thus equalizes the main reservoir pressure on both units. Air from the second main reservoir flows through the *H* filter to connection *6* of the FS-1864 or f-1864 relay valve and D-22-ER control valves on both units; on the A unit to connection *21* of the S-40-C independent brake valve and to the M-3-A feed valve and M-3A reducing valve; on the B unit to the SA-5 hostler brake valve. Reducing valve air at the pressure controlled by the adjustment of the reducing valve, flows through the reducing valve pipe and through the C-1-3-6 strainer and check valve to the signal pipe, charging this line to approximate reducing valve pipe pressure. On the A unit the feed valve reduces the main reservoir air to its setting of 110 lb. and feed valve air flows to connection *21* of the MS-40 brake valve, choke *115*, past the non-return check valve *90* to chamber A above rotary valve *54*, and through branch port *21a* to the chamber of inlet valve in the self-lapping portion. With either the brake valve handle or foot valve pedal held down, the air flows through pipe *21* to the *21* connection of the M-2 brake application valve, charging chamber *A* back of the piston *4*, and through choke *K* in the piston, charging chamber *B* on the face of the piston. From chamber *B*, the flow continues through passage *10b*, cut-out cock *19* and passage *10a* to pipe *10* and the diaphragm cut-off valve, lifting the lower diaphragm of the latter and flowing to the foot valve. With the foot pedal released, the flow continues through pipe *3* to the MS-40 brake valve, thence through passage *3* to the pilot valve *21* at the top of the brake valve. With the brake valve handle held down, the pilot valve is seated and the safety control system charged to feed valve pressure setting. The pressure thus equalizes on both faces of piston *4* of the M-2 brake application valve and spring *12* holds the piston and attached slide valve in release position. If the foot pedal is held down, the brake valve handle may be released and the safety control pipe is held charged up to the foot valve where the diaphragm is held sealed by pedal pressure, preventing the flow to the brake valve pilot valve exhaust. With the M-2 brake application valve in release position the reduction limiting reservoir is connected to the M-2 brake application valve exhaust through passage *24*, choke *N* and ports *Z* and *C* in the slide valve to exhaust *Ex*. Feed valve air, at the pressure controlled by the

* This is the continuation of a series, the last of which appeared in the August, 1944, issue.

adjustment of the feed valve, flows through a pipe to connection *21* of the MS-41 brake valve, thence past a check valve to chamber *A* above the rotary valve. With the brake valve handle in release position, air from chamber *A* flows through port *a* in the rotary valve and pipe *2* to connection *2* of the M-2 brake application valve, thence through passage *2a* to the chamber above the cut-off valve head, and through passage *2* to the slide valve. With the latter in release position, cavity *V* connects passages *2* and *2b* so that feed valve air flows to the spring chamber beneath the cut-off valve piston. Air pressures below and above the cut-off valve piston, therefore, are equal and the spring holds the cut-off valve unseated, permitting the feed valve air to flow from passage *2a* past the cut-off valve head to passage *1a,* pipe connection *1* and pipe *1,* through the double heading cock, thence to the brake pipe, charging it to feed valve pressure. In the M-2 brake application valve passage *1a* also connects to chamber *F* of the equalizing piston valve portion, charging it to brake pipe pressure. At the MS-40 brake valve, port *b* in the rotary valve connects the feed valve pressure from chamber *A* to pipe *4* and connection *4* of the M-2 brake application valve, thence through cavity in the slide valve to passages *5a* and *5,* thence to the equalizing reservoir and chamber *D* in front of the equalizing piston, and charging these to the same pressure as that of the brake pipe. As piston chambers *F* and *D* of the equalizing piston are charged equally, the piston is balanced and the spring holds the piston in charging position through lever *49,* and maintains the discharge valve on its seat. Discharge valve passage *16* is connected to pipe *16* and to the rotary of the MS-40 brake valve, where it is blanked. Thus, if the brake pipe chamber *F* charges faster than the equalizing reservoir chamber *D,* causing the piston to move and open the discharge valve, no brake pipe air will be lost, and the pressures will equalize and close the discharge valve when the two pressures become equal. A branch from the brake pipe connects to the MS-40 brake valve connection *1,* charging passages *1* and *1a* and the spring chamber of emergency valve and its pilot valve, which are held seated by their springs.

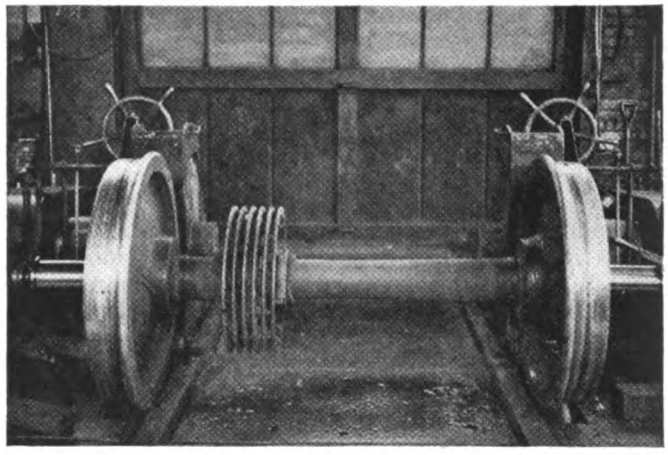
Grinder Saves Car-Wheel Metal

Since 1941 over 18,000 pairs of car wheels have been ground at the Western Avenue coach yard of the Chicago, Milwaukee, St. Paul & Pacific at Chicago. The practice is to grind all car wheels after they are turned. In order to conserve service wear metal, tread-worn-hollow wheels are put in the wheel lathe, the flanges cut down to the proper contour and height and the outer edge of the tread turned down, leaving the original wearing surface at the center. These wheels are then put in the grinding machine and the tread surface ground only just enough to true the wheels. It is estimated that at least 1/8 in. of wear metal per wheel is saved by this operation as compared with turning the entire wheel contour in the wheel lathe. In the case of the wheels having sharp flanges, full contour turning in the wheel lathe is of course essential.



Floor-type car wheel-grinding machine installed at the Western avenue, Chicago, car wheel shop of the C. M. St. P. & P.—Roller bearing wheels shown in the machine

A record of car wheels handled at the Western Avenue car-wheel shop shows that during 1944, 1,519 pairs of car wheels were turned, 1,656 pairs partially turned by the process just described and 4,567 pairs ground. The latter figure included all wheels turned plus those ground to remove flat spots. About 1/64 in. of metal is removed for each pass of the grinding wheel which is set on a taper to correspond with that of the tread. Two or three passes of the grinding wheel across the tread are usually required to remove a 2-in. flat spot.



Car wheel grinder and a pair of tread-worn-hollow wheels which have had the flanges re-formed and the outer rim cut down, leaving original metal in the tread to be trued by grinding

Unless there is a change in wheel size, practically no set-up time is required in rolling a pair of car wheels into the American Car and Foundry car wheel grinder and mounting it between the centers. In the case of wheels with ball-bearing journals, however, the front cover of the journal box on each side has to be removed and a wood block inserted to cover the bearing and protect it against abrasive particles. This wood block leaves the end of the journal uncovered and the axle center hole can be readily lined up for insertion of the ball-bearing dead center on each side of the grinding machine. Two operators are used on the machine which normally grinds from 14 to 16 pairs of wheels in eight hours. This is an average of somewhat more than 30 min. per pair of wheels, a production which cannot usually be maintained when there are many wheels with 2-in. flat spots.

The grinding wheels used on this machine are 2¼-in. wide by 30 in. in outside diameter and mounted on 12-in. mandrels which operate at 1,750 r.p.m. They are dressed occasionally with a diamond point tool, primarily to maintain the proper radius on the corner next the flange and are worn down until only about as thick as they are wide. The service life of each pair of grinding wheels is dependent on the type of wheel employed and the proportion of badly worn wheels. At the Western Avenue shop, one pair of grinding wheels will last to true the treads of 146 to 176 pairs of steel passenger-car wheels.

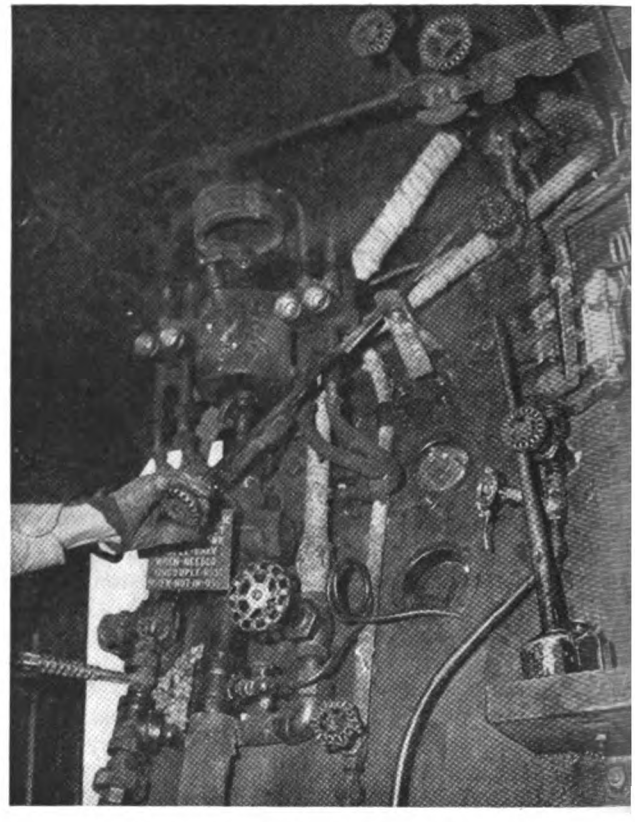
L. & N. Installs Improved Smoke Consumer

The steam-air jet for smoke abatement is an old idea and the first patent is said to have been granted to M. W. Ivison in England in 1838. Since that time, literally hundreds of variations of the original idea have been tried and some of them extensively used, but with rather meager and not entirely satisfactory results. During the last year or more, an improved steam-air jet, developed as a result of research conducted by Bituminous Coal Research, Inc., and extensive service tests on the Louisville & Nashville, has been installed on a number of L. & N. switching locomotives with outstanding good results, as shown in a public demonstration before city officials, smoke abatement engineers, railroad men and others at Nashville, Tenn., last October.

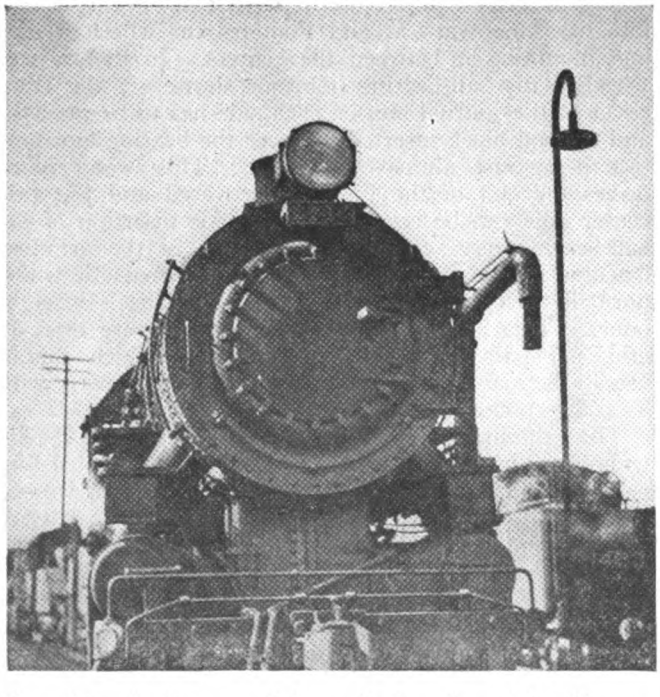
The principal difference between the new type of steam-air jet and the plain induction tube used on many roads is an air tube of optimum length, a smooth approach to the air tube, a steam nozzle accurately centered and positioned to give maximum air entrainment, and a silencer which acts like a muffler. This device is not patened or patentable and may, therefore, be made and used by any road interested. One of the illustrations shows three of these steam-air jets applied to the left side of an L. & N. switching locomotive and there are three on the right side applied in the same manner but staggered so as to give uniform coverage of the grate area.

The number and location of the induction tubes is important if good performance is to be obtained. They are horizontal and placed in the sides of the firebox. The tube nearest the fire door (generally on the left side) should be located approximately 16 in. from th inside door sheet and about one bolt higher than th bottom of the firedoor opening. The tube nearest the fi door on the opposite side of the firebox should be locate 28 in. or 29 in. from the inside door sheet; i. e., 12 in. 13 in. ahead of the foregoing tube and at the same heig above the mud ring. Successive tubes on either side the firebox are spaced approximately 24 in. apart, a approximately 16 in. above the grate. The tubes may lower toward the front to clear the arch. The inductio tubes may replace staybolts, or be located between sta bolts. The locations stipulated have been found to giv best results; and other appliances should be relocated, necessary, to admit of obtaining such locations.

The number of air jets and induction tubes require on any particular class of locomotive is dependent upo the grate area and coverage desired. In the experienc of the L. & N., it has been found that one 2½-in. indu tion, fitted with a 2¼-in. outside diameter air tube an $\frac{3}{32}$-in. steam nozzle is needed for each 10 sq. ft. of gra area for locomotives in switching service with burnin rates not in excess of 50 lb. per sq. ft. of grate per hou If burning rates exceed this amount the steam nozz may be increased in diameter to ⅛ in., which will tak care of 80 lb. of coal per sq. ft. of grate per hr. Exper ence on the L. & N. indicates that it is not advisable t exceed a steam nozzle diameter of ⅛ in. for an air tub of 2¼ in. outside diameter. For locomotives in roa service, burning rates much higher than the maximu in switching service are encountered and it is necessar



Cab view of over-fire air valve and blower valve

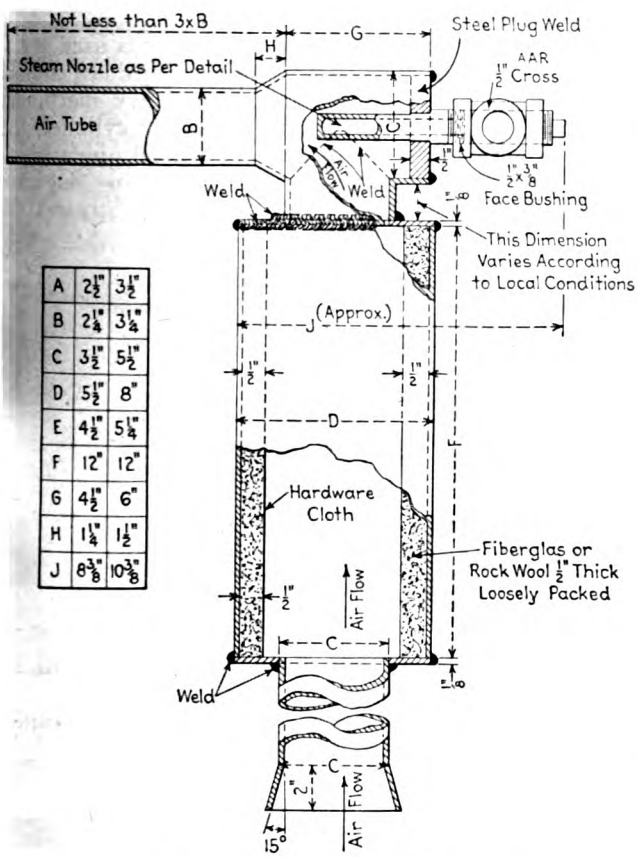


The safety valve is open and the stack clear after placing 40 scoops of coal in the firebox

to increase the induction and air tubes to 3½ in. and 3¼ in. outside diameter, respectively, dependent upon specific data covering grate width and length; heating surface; etc.

The L. & N. steam-air jet shown in the drawing is an improved design differing from the ones shown installed in the illustration. It is the result of considerable laboratory experimenting to obtain satisfactory sound performance as well as capacity and maximum entrainment ratios. The ones in the photograph of the locomotive were loosely packed with steel-wool to give an acceptable sound level. The steel-wool, however, had the disadvantage of offering resistance to the flow of air by plugging with road dirt and disintegration due to rusting. The improved design effectively overcomes these handicaps and also gives superior results in lowered noise level. They are made principally from boiler tubes and flues and a set can be readily made in any railway boiler shop.

The steam-air jets are left turned on virtually at all

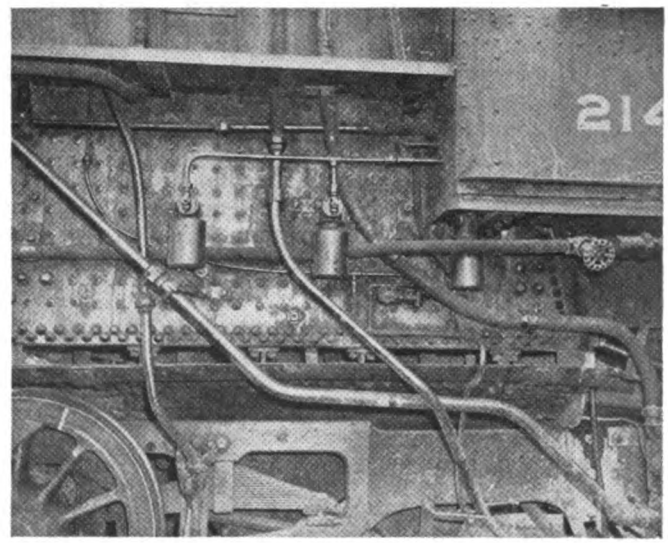


A	2½"	3½"
B	2¼"	3¼"
C	3½"	5½"
D	5½"	8"
E	4½"	5¼"
F	12"	12"
G	4½"	6"
H	1¼"	1½"
J	8⅜"	10⅜"

L. & N. improved Type A steam-air jet and silencer

times while the locomotive is under fire; while working in yards, standing and moving around shops and enginehouses; and whenever needed to avoid making smoke, such as while adding coal to the firebox, cleaning fires and building new fires. The stack blower is used for draft and elimination of smoke, following the general practice in this respect. The following instructions cover the operation of the device and if placed in a metal holder under glass in the cab, they will be accessible to the firemen and others.

(1) When going on duty, the fireman will first open the stack blower valve just enough to prevent the gases and smoke from coming out of firedoor and to raise the smoke from the stack.



Application of improved steam-air jets and mufflers to the left side of an L. & N. switching locomotive

(2) Open the smoke-consumer valve (indicated by a small plate "Smoke Consumer" and operated from the fireman's seat). Firemen will keep this valve open while on duty, in transfer as well as short switching service to provide a constant flow of air over the fire; also, the valve should be kept open after the locomotive is delivered to the enginehouse.

(3) Before leaving the enginehouse, see that the air induction tubes are in operation, i. e., blowing air over the fire. If not, have the steam nozzles cleaned.

(4) Place a bank in the firebox, higher at the door sheet than along the sides, but do not cover the induction tubes.

(5) If smoke is not altogether dispersed by the smoke consumer, gradually open the stack blower valve until the smoke is cleared up. Do not use the blower any more than necessary to free the stack of smoke.

(6) Maintain a U-tank at all times, and after adding coal to the fire, keep the firedoor closed.

(7) The 1-in. globe valve under the operating valve to the smoke consumer is for enginehouse use only.

The Louisville & Nashville now has 50 switchers, one 2-8-2 heavy freight locomotive and two light 4-6-2 locomotives equipped with steam-air jets. Authority has been granted to equip a total of 99 switchers used at various terminals of this road. A number of other roads also utilize steam-air jets patterned after the L. & N. design.

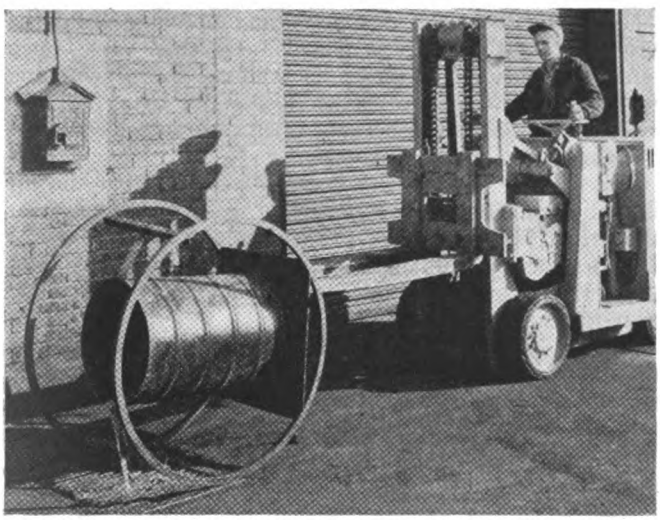
One Way to Set Locomotive Valves

Here is a shop tested time saver that will save several man-hours on every engine that passes through the shop. In setting valves by trailing it has long been considered necessary to move the engine forward to square the forward motion, and then move it backward with the valve gear in the back-up motion to square the back-up motion. It has been found possible to square the back-up motion without moving the engine backwards, the valve gear is placed in the back-up position in the usual manner but the engine is moved forward when taking the back up travel marks. This method makes it possible to set valves on the fly while the engine is being cabled out

of the shop across the transfer table to the firing shed and gives a straight line movement out of the shop without the necessity of changing the cable to move the engine back and forth across the transfer table, while a number of craftsmen stand by waiting to get a chance to work on it. The method is sound in theory, for a little study will show that the direction of rotation of the wheels has no effect on the length of the valve rods and eccentric rods and that the effect of any lost motion will be the same regardless of the direction of rotation of the wheels.

Roll-Over Drum Disposal

Floyd Bliven, salvage supervisor at General Electric's Erie Works, developed this roll-over drum which easily disposes of wet grinding sludge, and similar waste. An open-top drum welded to a metal base plate is framed with two metal hoops, held rigid by angle-iron braces.



Disposal drum that can be handled and dumped by fork truck

The drum is easily transported by means of an electric fork truck from various machines to the drain. After lowering the drum to the ground, the operator moves the truck back until the fork tips are under the edge of the base plate. As the forks are slowly raised, the drum rolls over and the waste is emptied. The drum is automatically returned to an upright position by the weight of its base.

Questions and Answers On Welding Practices

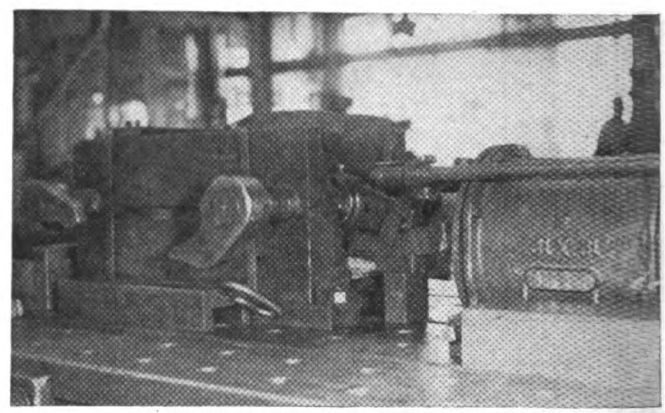
Safety in Welding

Q.—Is there any recognized standard code governing safety requirements for welding?

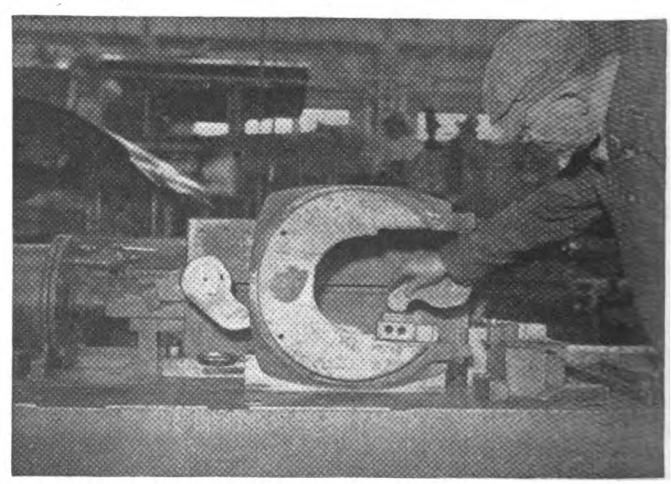
A.—Although safety factors involved in welding have been dealt with by manufacturers, insurance companies and others in the form of instruction pamphlets, the only work which might be termed a code has been prepared by the American Standards Association. The committee preparing a report on safety in electric and gas welding and cutting operations was composed of representatives of equipment manufacturers, users, insurance companies, the National Safety Council, and government regulatory bodies. The report was reviewed by hundreds of manufacturers and users and finally released under the title, Safety in Electric and Gas Welding and Cutting Operations, by the American Standards Association, 70 East Forty-fifth street, New York. Single copies sell for 40 cents. It should be remembered that this is not a legally binding code but a standard which is intended as a guide for the protection of workers from injury and illness and for the protection of property from fire or other damage arising out of the installation, operation, and maintenance of electric and gas welding and cutting equipment.

Machining Driving Boxes

A jig for mounting on the table of a planer is used at the Spencer, N. C., locomotive shop of the Southern to hold two driving boxes in position for necessary machining operations. The jig is operated by an air cylinder, the piston exerting pressure on a wedge-shaped guide which in turn rotates round bars to which clamping dogs are fastened. As the wedge guide advances it rotates the



A wedge-shaped guide operated by the air-cylinder piston rotates the bars to which clamping dogs are fastened



Clamping dogs hold the driving boxes firmly on the machine table

dog bars until they exert maximum pressure against the driving boxes which are mounted on each side of the jig. One dog fits on the inside of each box while another fits against the top of each, the boxes being held so firmly that maximum cuts can be taken without any possibility of the boxes moving.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Flow of Water Through Openings

Q.—If a fusible plug has an orifice of ½ in. diameter and the tin in the plug has been melted out, how many gallons of water per minute will be discharged through this orifice with a steam pressure of 250 lb. on the boiler?—L. S.

A.—The formula for computing the flow of water under pressure through an orifice is:

$$V = 0.98 \sqrt{2g\,(h + h_1)}$$

when

V = velocity of flow in ft. per sec.
g = 32.16
h = head in ft.
$h_1 = \dfrac{P}{0.434}$
P = pressure in lb. per sq. in.; 0.434 lb. per sq. in. for one ft. of head.

The formula for quantity of flow is:

$$Q = 0.61\,AV$$

when

Q = discharge in cu. ft. per sec.
A = area of orifice in sq. ft.
V = velocity of flow in ft. per sec.

Applying these formulas to the problem in question assuming that the fusible plug burned out because of scale, there being three inches of water over the crown, the head *h* would then be three inches or 0.25 ft.

$$V = 0.98 \sqrt{2 \times 32.16 \left(0.25 + \frac{250}{0.434}\right)}$$

$$V = 0.98 \sqrt{64.32\ (0.25 + 576)}$$

$$V = 0.98 \sqrt{64.32 \times 576.25}$$

$$V = 0.98 \sqrt{37{,}064}$$

$$V = 0.98 \times 192.5$$

$$V = 188.65 \text{ ft. per sec.}$$

$$Q = 0.61 \times \frac{0.19635}{144} \times 188.65$$

$$Q = .1565 \text{ cu. ft. per sec.}$$

1 cu. ft. = 7.481 gal.

$$.1565 \times 7.481 \times 60 = 70 \text{ gal. per min.}$$

Vertical Welds

Q.—It is necessary to fabricate the sides of a tender tank from several plates joined with vertical butt welds. In making these should the direction of welding be up or down?—R. D. M.

A.—If possible, the sides of the tank should be welded in a horizontal position. Sections should be joined with as few vertical welds as design permits. The selection of the direction of welding for vertical joints involves not only the direction of welding, but also the characteristics of the resultant bead and joint. Generally, it is easier to weld down. On certain joints it is quite difficult to weld up without the use of a backing-up strip. For example, on a single-vee butt weld it is very difficult to put in the first bead when welding up. When a backing-up strip is used, or the weld is a fairly heavy fillet, or the type of joint has good heat capacity, welding up may be done fairly easily. Care must be taken to eliminate slag and incomplete fusion at the side of the bead to avoid undercutting.

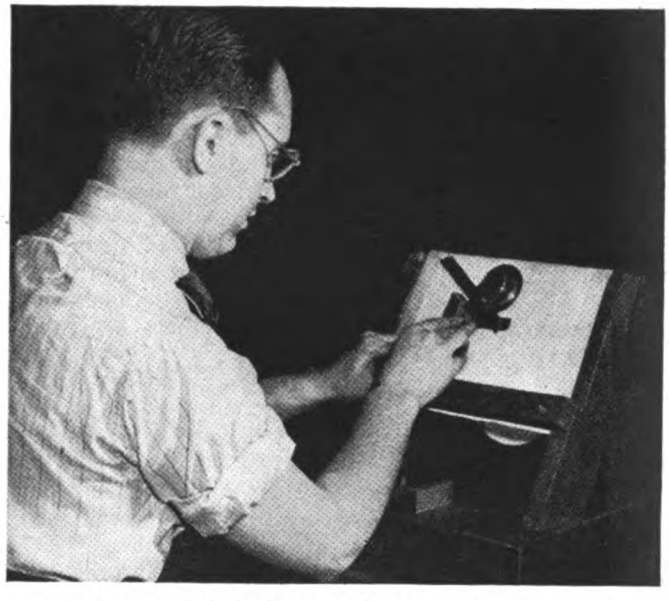
Welding down produces a concave bead, with practically no undercutting and fine-grain structure due to multiple beads, with resulting greater cleaning time because of the greater number of beads. On the other hand, welding up produces a more abrupt change in contour at the toe of the bead. The bead is convex and fusion is more easily obtained at the heel of the bead.

It is obvious that to recommend only one direction of welding is impossible unless the type of joint, the type of electrode, and what is required in the completed joint are known.

Ground Glass Inspection Plate

An illuminated ground glass inspection plate has been devised at General Electric's Pittsfield Works as a simple quick means of checking angles on tools or matched cutters. The glass is set in a wooden frame at an angle of approximately 65 deg. The light source under the plate is a standard 100-watt lamp.

The tool being checked is placed on the plate and the protractor or template is placed against the side of the tool. Any error is immediately discernible. The method provides a positive check against the true cutting edge of the tool, which is not always possible when the protractor is held in one hand and the tool in the other.



Angles are readily checked with this illuminated background

This inspection plate is inexpensive and simple to make, and can be replaced easily if broken. It can be used by inexperienced persons, and is adaptable to a variety of inspection jobs.

Safety Factors in Arc Welding

By R. F. Wyer*

A discussion of the hazards and required safety practices from the electrical point of view

THERE is one peculiarity which distinguishes the arc-welding operator's job from other occupations. Arc welding is the only widely practiced industrial occupation in which the operator handles a live electric circuit all

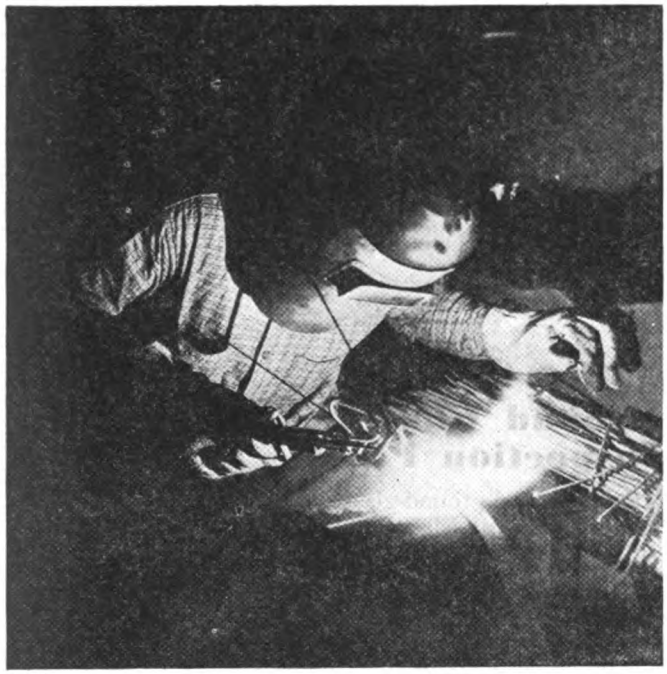


Fig. 1—Atomic-hydrogen arc welding on aluminum

day. Yet, in spite of all the implications of that fact, the danger of electric shock to the operator is not as great as is often supposed.

In addition to electrical hazards, arc-welding operation involves some fire risks as well as the ordinary mechanical hazards to the workman which are common to almost any industrial occupation. But these are not peculiar to arc welding. The presence of fumes and smoke is likewise not peculiar to the arc-welding process, and ordinary means of dilution and removal are employed. The medical aspects of this matter are the subject of careful investigations in a quantitative way, but they all point to adequate ventilation as the practical hazard-preventative measure.

Radiation of ultra-violet and infra-red wave lengths from the arc are sometimes regarded as serious hazards. They are not, in the sense that their effects can easily be prevented by commonly used protective helmets and clothing. Mystery rays are not present, although it is surprising how many times the rumor crops up that this or that arc-welding equipment gives off radiations which result in sterility or peculiar ailments such as might be attributed to X-rays. Such rumors have been disposed of effectively by having welding operators carry in their clothing pieces of photographic film for weeks at a time. None show the slightest evidence of radiation.

Electric Shock

The hazard of electric shock is the one of greatest interest in arc welding. It is not as common a source of injury or death as might be suppposed from casual acquaintance with the subject, and because there are definite ways in which even the small hazard can be almost completely overcome. It is difficult to compile records of shock casualties because insurance statistics are not broken down quite far enough to reveal the needed data. Also, rumors and newspaper publicity are notably inaccurate when dealing with deaths in the arc-welding field. The following are reports of one accident from different papers in the same city. "Stumbled and fell in such a manner that the electrode on his welding instrument was jammed in his mouth. The charged connection sent 550 volts through his body, killing him instantly." And, "Fell dead after 440 volts passed through his body. His heavy clothing, which all workers in the shop are required to wear for safety, was soaked with perspiration and, as he accidentally touched a highly charged arc rod used by another worker, a short circuit was caused and the power passed through his body." As a matter of

Fig. 2—Tank and boiler construction and repair frequently requir working in confined spaces

* Application engineer, Electric Welding Division, General Elect Company.

fact, careful measurements immediately following the accident showed a maximum of 76 volts available to shock the victim.

Some concrete information is available, and it shows a perhaps surprisingly small number of fatalities from this source. One insurance company reported that among one group of policy holders, electric shock was the least

Fig. 3—This operator is using an uninsulated electrode holder and the cables coiled carelessly under his feet and legs may trip him when he rises

frequent cause of occupational death classified—fewer deaths being attributed to shock than to falls, machinery, railroads, or even drowning. This in spite of the fact that the group must have included electricians and workers in electrical manufacturing plants, and in spite of the often evidenced tendency to attribute death to electrocution in any doubtful case where a live electrical conductor is present at the scene.

In a survey made among four manufacturers using arc welding, selected at random and not including General Electric, these figures were obtained for the year 1941: There were a total of 14,475 industrial workers employed by the four manufacturers, with a total of 13 fatalities, or one death per 1,110 workers. Included in these totals were 1,125 arc welders, among whom there was one fatality.

G. E. plants have for many years employed arc welders, with as many as 1,500 welding operators employed at one time before the peak in this employment. In the last seven years there has been but one fatal accident to a welding operator. This one was in 1938, and there is considerable doubt as to whether death was caused by electrocution or by a fall.

The district supervising engineer of one large insurance company stated in 1942 that, as measured by compensation rates, arc welding is only 75 per cent as hazardous as gas welding. Yet gas welding is not generally considered a very hazardous occupation.

In 1942, still another insurance company reported about one electrocution case per month for the preceding two years, only two of which involved arc welding. These two cases were the only ones they had had for many years.

While no figures on the total employment of arc welding operators are available, a conservative estimate based on industry sales of arc-welding equipment and on the consumption of electrodes gives a figure well over 200,000 for the year 1943. So far, available records indicate only four electrocutions among arc-welding operators during the entire year 1943. The shock hazards which do exist might be classified with relation to equipment and its layout, maintenance, supervision, and operator education.

Circuit Voltages

Fig. 1 shows atomic hydrogen arc-welding equipment in operation, and brings up the perpetual question of the relative hazard in a. c. and d. c. welding. Here there is at times a potential of 300 volts between the two slender electrodes projecting up and to the left from the arc. It is alternating-current. No case of severe shock, and no fatalities resulting from the use of this equipment have ever come to our attention.

The point is made to demonstrate the fallacy of arguments, based on clinical or laboratory experience, as to the difference between a. c. and d. c. with respect to shock hazards. In this equipment an adequately insulated electrode holder is used, and factory designed and built protective equipment disconnects the power when the arc is not actually in use.

Exhaustive studies on let-go currents, made at the University of California, definitely prove that under laboratory conditions a victim is less likely to freeze onto an electrode with d. c. than with a. c. at a given current in milliamperes. But to draw the conclusion that d. c. welding is invariably safer than a. c. welding is to ignore the factors of voltage, insulation, protective equipment, skin resistance, and physical condition of the subject.

The extremes to which interpretations of these tests may go is indicated by the recent development of a theory, by a welding supervisor, that while 24 volts is

Fig. 4—The insulation of this electrode holder is broken

safe, 28 volts is dangerous. Or by the performance of another welding supervisor, who knelt in water on a steel deck and grasped an electrode with soaking wet gloves, to demonstrate that one can feel 35 volts, but not 10 or

12. If such a demonstration ever convinces a welding operator that it is safe to place the body intentionally across any electrical circuit, it may well be a contributing factor to his untimely death.

Most welding sets receive power at voltages from 220 to 550, but the welding circuit on all properly designed machines which may develop 50 to 100 volts is effectively separated from the power circuit by the insulation in the machine or transformer. Some a. c. welders have a built-in control panel which automatically reduces the voltage on the welding circuit to about 30 volts within one-fifteenth of a second after the welding arc is extinguished, as when the electrode must be changed. Touching the electrode to the work automatically puts full power on the welding circuit again.

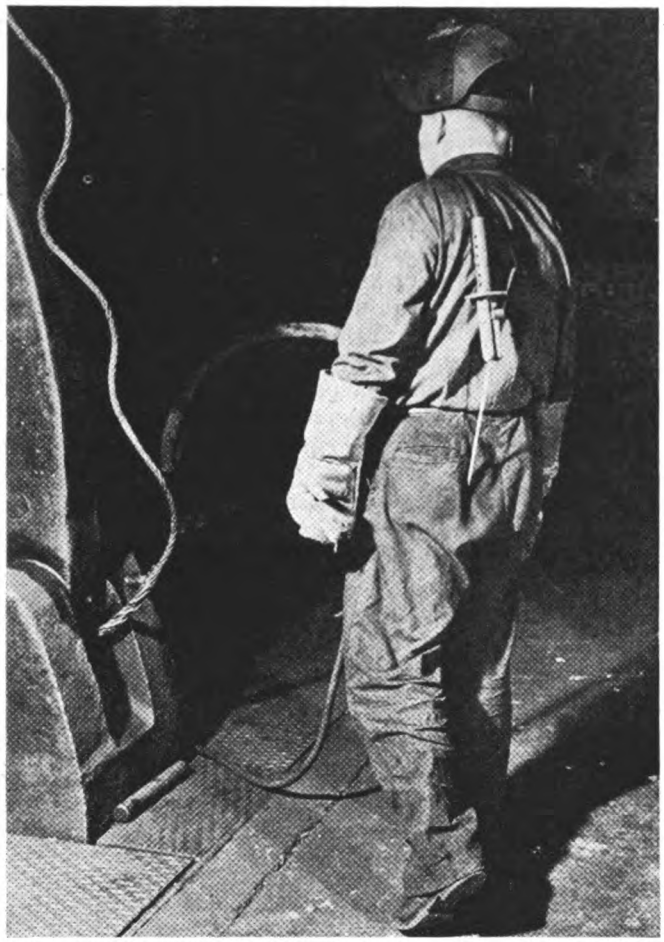


Fig. 5—Arc-welding operator should never sling electrode holder over his shoulder, nor leave an electrode in a holder not in use

Grounding

The major safety point in the installation of arc-welding equipment is the necessity of grounding the frame of the welding set, whether it is an a. c. or d. c. unit, or whether it is stationary or portable. Common sense, as well as the National Electrical Code, demand that this should be done. An ungrounded unit, even one in perfect condition, can give annoying shocks and tickles to a grounded individual, because of the inherent ability of an electrical circuit to induce a static charge on another conductor separated from it by insulation. The effect is the same as that in a condenser, or Leyden jar.

In the event of failure of the insulation, due to age, abuse, or accident, the frame of a unit may become charged to full power circuit voltage, with serious consequences, unless the frame is grounded. If the proper ground connection is in place, however, the frame cannot have a voltage to ground, and the only effect of such a failure will be the blowing of fuses or tripping of circuit breakers and disconnection of the unit from the line.

This immediately suggests the necessity of installing adequate overcurrent protection and switches in the power circuit to the welder. Fuses or circuit breakers must be capable of interrupting the maximum current which may be drawn by a short circuit in the motor or power leads of a d. c. welder, or in the primary circuit of an a. c. welder. Disconnecting switches must be capable of interrupting the stalled rotor current of the d. c. machine, or the maximum current which can be drawn by the a. c. unit when the welding electrode is short-circuited on the work.

On the welding-circuit side of a unit, care should be taken to avoid the possibility of getting double the normal circuit voltage between two adjacent welding circuits because of the connection of one unit with one polarity and the other with opposite polarity. On a. c. units abnormal voltage of somewhat lower value can also be obtained if adjacent welders are operated from different phases of the supply line. This factor has rarely, if ever, caused serious trouble because of the small likelihood that an operator will get hold of two welding circuits at once.

Electrode Holders

Probably the most important item in equipment, from the safety point of view, is the electrode holder. Although uninsulated holders have been used in arc welding for many years, good practice unquestionably requires that fully insulated holders should be used.

Fig. 6—Arc-welding operator should be particularly careful when working above the floor or ground, since many fatalities are caused by falls

Fig. 2 not only shows an uninsulated electrode holder but, incidentally, an ideal set-up for potential trouble. The operator is in a cramped space, and also undoubtedly in contact with the conducting metal in a number of places on his body, unless his clothing is dry and his shoes free from nails. In his hand he holds an electrode holder which has a handle of insulating material,

through which extends an uninsulated screw-head. Probably any contact he might make with the screw, through wet gloves or with the bare hand, would be too small in area to permit electrocution. But a shock may make him do something involuntarily, which will put him in danger. The worst feature of this holder is that the head, projecting out beyond the ring or collar of insulating material just above the hand, is entirely uninsulated. Each time the operator changes welding electrodes, there is a good chance that he will contact this exposed metal. If he should fall on the holder, or sling the cable over his shoulder or around his neck, as is frequently done, this live conductor may contact his chest or back.

There are now several types of good insulated electrode holders on the market. They should be used on any welding job, and their insulation should be kept in first-class condition. Studies of accident reports reveal, in a good percentage of cases, evidence that uninsulated electrode holders caused or contributed to death.

Maintenance and Supervision

Maintenance and supervision play an important part in the safety side of welding, as is the case in almost any other process. Fire hazards should obviously be watched for and, when found, eliminated. Welding cables and their connectors should be examined frequently for breaks in insulation. The extremely hard service to which welding cables are subjected often results in severe damage to the insulation. Yet the welding operator, accustomed to arcs and sparks in his daily work, often disregards accidental short circuits which spell trouble to the safety man or the fire inspector. Likewise, welding return-circuit connections should be given attention by supervision. Arcs or flashes in unexpected places along the return path of the welding current may result in fire hazards if indiscriminate use is made of returns consisting of building piping, reinforcing rods, scrap lengths of pipe, or bars laid together.

The maintenance of adequate safety ground connections to the frames of all welding machines should be checked, because many operators do not realize their importance. For the same reason, the maintenance of insulation on electrode holders should not be left to operators alone. Electrical repairs and connections on the power-line side of the welder should be handled only by competent men. In the last analysis, it is obvious that the welding operator and his safety education plays the greatest part in preventing accidents to himself.

Safety Rules

The paramount warning should be to take particular care in hot and humid weather, and when welding in wet places. Almost without exception, fatal accidents to welders occur in hot weather. The operator's own condition and that of his clothing should be his guide. He should always guard against wet gloves, shoes, and clothing, particularly clothing made of thin cotton fabrics.

The operator should assume the major responsibility for seeing that the insulation of the electrode holder is in good condition.

He should learn to carry an electrode holder by the handle, never slung over his shoulder, or squeezed under his arm.

He should never, under any circumstances, transport an electrode holder with an electrode or electrode stub in it.

He should never throw or lay an electrode holder down so that it makes contact with any conducting material.

He should never work alone in confined or concealed spaces where, for example, striking his head may cause temporary loss of his faculties.

He should be particularly careful when working above the ground or floor, since it is significant that many fatalities involve a fall.

Case studies, incomplete as they usually are, give a basis for these recommendations. For example, in all but one of nine reports of accidents, dating from 1934 to 1943, the statement was made that the weather was very hot, or that the victim's clothing was soaking wet. In five of these nine cases, a fall was involved, ranging from a height of eleven feet to the case of a standing man who fell to a steel floor. In every one of them, the electrode holder was uninsulated, and in none was there evidence of contact with any live part other than the electrode holder. Four of the cases involved arc-welding operators working in confined spaces.

This discussion can be summarized as follows:

1.—Arc welding is not a hazardous occupation, as judged by industrial standards.

2.—Electric shock is a relatively infrequent cause of death.

Where electrocution of the welding operator has occurred, one or more of three factors was usually involved: (1) an uninsulated electrode holder; (2) wet gloves and clothing; (3) a fall.

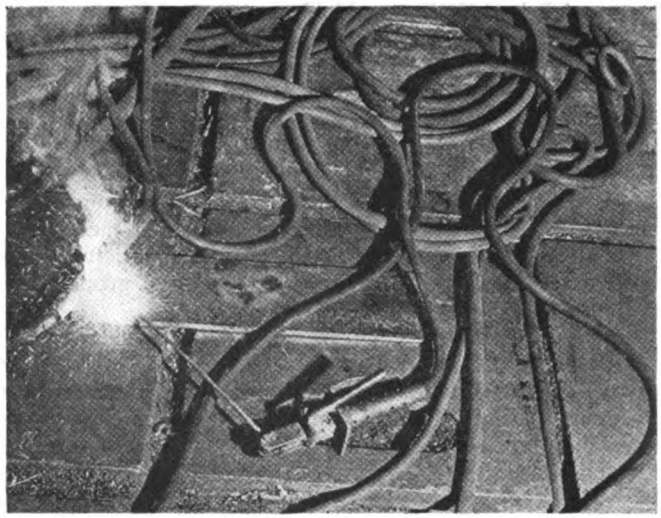


Fig. 7—Electrode holder should never be thrown or placed where it can make contact with conducting material

Grounding of Circuits On Cars and Locomotives*

A study of the National Electrical Code and other safety regulations with reference to circuit grounding indicates that inside circuits are grounded to limit the voltage which may be impressed on a circuit by exposure to, or conflict with, higher voltage lines; or to limit the maximum potential to ground which may result from the normal operating voltage.

These limitations, which grounding is supposed to impose, are sought primarily in an endeavor to reduce the hazards from fire and electric shock or burn. A secondary objective is to minimize the hazards to service; for example, service interruptions. Also, circuits may

* Abstract of a paper, "Grounding of Circuits on Self-Propelled Vehicles," by D. D. Ewing, professor of electrical engineering, Purdue University, presented at the winter technical meeting of the American Institute of Electrical Engineers in New York, N. Y., January 22-26, 1945.

be grounded to facilitate trouble indication and location, to provide for more accurate and reliable circuit protection, and, in some cases, to simplify the circuit layout and to allow a more economical construction.

The circuits which are used in self-propelled vehicles may be classified rather arbitrarily, as:

(a)—Single-conductor circuits with "ground" returns. In a vehicle the ground return is a path through the locomotive or bus frame from the motors to the power source. In the ordinary electric-railway distribution system the track rails and ground form the ground return to the power supply.

(b)—Two-conductor circuits with both conductors insulated.

(c)—Two-conductor circuits with one conductor grounded. The "ground" may be at one point or at several points. It may be a "dead" or solid ground, a ground through a resistance, a fuse or a protective relay of some sort, or through a combination of these components.

As used here the term "vehicles" includes electric locomotives steam-electric locomotives, Diesel-electric locomotives, storage-battery locomotives, street-cars, electric motorcars, trolley buses, gas-electric buses, Diesel-electric buses and gas buses, and automobiles used in public transportation service. Also, the foregoing classification covers only d.c. and single-phase a.c. circuits.

In the selection of the proper circuit for a given service the engineer does not always have a free choice. For example, the power circuits of electric motorcars and locomotives which operate on rails and receive their power from an outside source ordinarily must use the class (a) circuit. Similarly, for practical reasons, the main circuits in a trolley bus must belong to class (b).

The choice is not so restricted, however, for the following circuits:

1—Traction motor circuits on steam-electric, Diesel-electric, and conversion-type electric locomotives.

2—Main power circuits on gas-electric and Diesel-electric buses and trucks.

3—Starting, lighting, and other auxiliary services on buses, trucks, and automobiles.

4—Auxiliary circuits on electric motorcars, locomotives, and trolley buses.

5—Electric circuits on railroad passenger cars.

This lack of restriction has resulted in a considerable diversity of opinion among engineers with a corresponding diversity of practice among equipment users.

Common questions which arise are: Should the main power circuit on a Diesel-electric or gas-electric bus or locomotive be grounded or kept well insulated? If grounded, should the ground be a solid ground or a resistance ground? Should the circuit be grounded through a fuse or a relay? Should control, lighting, and other auxiliary services use grounded or ungrounded circuits?

The outstanding advantages of the single-conductor ground-return system are simplicity of circuit layout, low first cost, and the quick detection and ease of location of faults. Its disadvantages are the lack of constancy in circuit resistance and the fact that a fault on the single conductor may render the circuit inoperative at some time when operation of some sort is absolutely necessary. Circuit-resistance variations are caused by loose rivets, bolts, joints, and so forth, in the mechanical parts. These poor contacts may result in burning and corrosion of the metal frames and leakage through the bearings may cause serious bearing trouble.

The system of employing two insulated conductors has the advantage of making possible a high degree of circuit insulation and isolation. It is practically the only choice for all circuits fed by trolley voltage in the trolley bus. Circuit resistance is easy to maintain at a constant level and the likelihood of failure is less since there must be a fault on each line before complete circuit failure can occur. This advantage becomes a real disadvantage, however, when the matters of fault indication and location are considered. This circuit costs more and there seems to be a trend toward its increased use in the better class of vehicles. In some services, where a common return wire is used, the insulated circuit is at a disadvantage as compared with the ground-return circuit. This is notably true in the case of certain control and signal circuits where an opening in the common return wire might cause false indications or false operation.

Circuits of the third class (those with two conductors, one of which is grounded) have a wide field of application, potentially at least. They are high in first cost and maintenance but provide current paths of constant resistance and a ready means of fault indication and location. Such circuits appear to be particularly applicable to the traction motor circuits on a.c. and Diesel-electric locomotives and, in general, wherever a circuit path of high integrity is required.

Conclusions

Giving due consideration to matters of economy, circuit requirements from a power standpoint, and to the reasons underlying circuit grounding, the following conclusions may be drawn:

1—All circuits on trolley buses which operate at trolley potential must be of the two-conductor type with all wires and apparatus well insulated from the bus body and other parts accessible to passengers or street traffic.

2—All low-voltage circuits on small buses and automobiles used in passenger service may be of the one insulated-conductor ground-return type.

3—All circuits carrying small currents at low voltage (6 to 32 volts) which are thoroughly isolated from possible exposure to, or conflict with, higher voltages and which are accessible in any way to passengers or street traffic may be of the one-insulated-conductor ground return type.

4—Ground-return circuits should not be used on trucks or other vehicles carrying gasoline, oil, or other highly inflammable or explosive materials.

5—All so-called "ground-return" circuits, where there is possibility of a loose mechanical joint in part of the return circuit, should have the return of bare copper conductors electrically connected to the mechanical part at a number of points.

6—All internal circuits carrying heavy currents at both low and high voltages (starter-motor circuits on automobiles and small buses excepted) may be of the two insulated-conductor type with one conductor grounded. The two conductors here serve as a guarantee of circuit integrity and the grounded connection is of assistance in fault indication and location, keeps static charges drained off, and otherwise assists in protecting apparatus and service. This classification is not intended to include circuits which are fed from an external source such as trolley wire or third rail.

7—All circuits on rail vehicles connected to external sources of power such as trolley wires and third rail are necessarily of the one-conductor-with-ground-return type or of the two-conductor-with-one-conducto grounded type.

(*Continued on next left-hand page*)

THE 7 RIGID TESTS THAT GUARANTEE UNIFORMITY

1. Chill test block taken at least once in every ten wheels poured.
2. One complete chemical analysis with each heat.
3. Constant pyrometer checks for accurate processing temperature.
4. Drop test of finished wheel (A.A.R. Specifications).
5. Thermal test of finished wheel (A.A.R. Specifications).
6. *Test for Rotundity.*
7. Brinell Hardness test for maximum and minimum chill limits.

Test No. 6

TEST FOR ROTUNDITY:

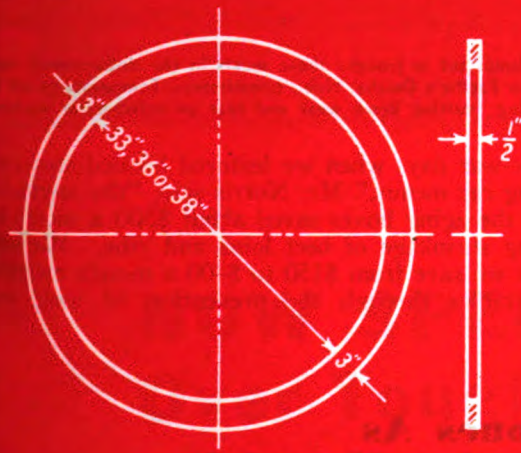
Rotundity is an extremely important consideration in a car wheel, so much so that the A.A.R. Specifications place a limit of 1/32-in. on this feature.

The process employed in the manufacture of chilled car wheels is admirable from the standpoint of achieving rotundity.

A chiller ring is employed, which forms the flange and tread section of the mold into which the molten metal is poured.

This chiller ring is machined to perfect rotundity, to produce the prescribed tread and flange contour, and the casting naturally follows the contour of the accurately machined chilling surface of the chiller.

Accompanying drawing shows the A.A.R. standard gauge for checking the rotundity of wheels.



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8—Control and signal circuits using a common return wire may have this common return grounded on car or truck frames at a number of points whenever other circuit conditions are such as to permit grounding. The grounding of the common return will tend to reduce false indications or operations in case of return-wire breakage.

9—Three-phase 220-volt circuits used on railroad cars to supply air-conditioning equipment should not be grounded. However, the structural parts of the cars should be solidly grounded.

10—All a.c. and d.c. circuits on railroad cars with voltage ratings of 64 to 120 volts should be of the insulated-conductor type. If an a.c. circuit is fed through a transformer from a higher-voltage circuit then the lower-voltage circuit should have one conductor grounded. Also, if such a circuit is exposed to static from belts or moving air streams, one side of the circuit should be grounded.

It does not seem feasible to make a complete classification of all the circuits used in vehicular service and categorically state that such and such circuits should always be grounded and certain others should not be. The safety, economic, and technical factors are somewhat different in the different transportation fields, and these factors should be given some weight in the consideration of any recommendations relative to standardization.

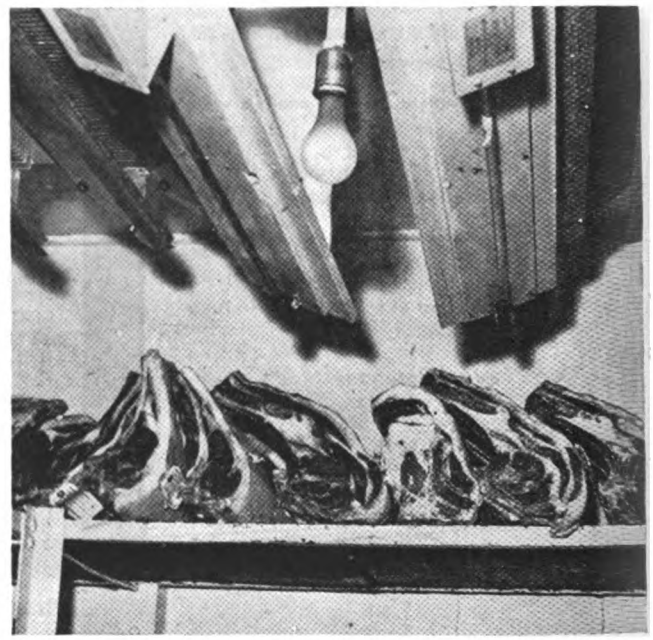
Recommendation

Standards in some of the operating fields have been set up by the American Association of Railroads, in others by the Society of Automotive Engineers, and in still others by the American Transit Association. In those fields where these several associations have what for convenience may be called primary jurisdiction, the standardization problems have on the whole been cared for promptly and effectively. Under present conditions there is a considerable amount of overlapping. For example, the power equipment on a Diesel-electric locomotive from one viewpoint may be considered as just overgrown Diesel-electric bus equipment. The question arises as to who shall set up the needed equipment standards in such a case? Shall they be set up by manufacturer's associations, by professional engineering groups, or associations of operating companies? The question is a difficult one. Obviously some things belong in one place and some in another. In this case it is possible that better end results will be produced if the work is done by joint committees working under the sponsorship of a professional engineering group. It would seem to be a proper recommendation, therefore, that the American Institute of Electrical Engineers act as sponsor in this instance and set up the necessary mechanism for working out the desired standards and recommended practices.

Germicidal Lamps In Railroad Service

In an effort to prevent the spread of colds and other contagious diseases, the Union Pacific is installing ultra-violet lamps in the bar cars of the City of Denver and plans to introduce them eventually on all of its streamliners. The lamps are arranged so that the rays are directed upon racks of washed and dried bar glasses. Ultra-violet lamps have also been placed over work tables in the commissary at Omaha, Neb., where from 1,200 to 2,000 box lunches and 12,000 additional sandwiches are prepared daily.

These innovations for the protection of passengers, according to H. I. Norris, assistant to the manager of the dining car and hotel department, follow experiments with the lamps in the refrigerators on some of the streamliners and in meat aging refrigerators at Omaha to prevent waste and spoilage of food due to the growth of mold.



Sterilizing lamps set in troughs above meats in the disbursement room at the Union Pacific's Omaha, Neb., commissary—Temperatures can be raised 10 deg., cutting down wear and tear on refrigerator machines

"In pre-war days when we featured broiled steaks on our dining car menus," Mr. Norris said, "the sterilizing lamps in the aging boxes saved about $500 a month by preventing shrinkage of beef loins and ribs. We estimate that we save from $150 to $400 a month on fruits and vegetables through the prevention of mold and spoilage."

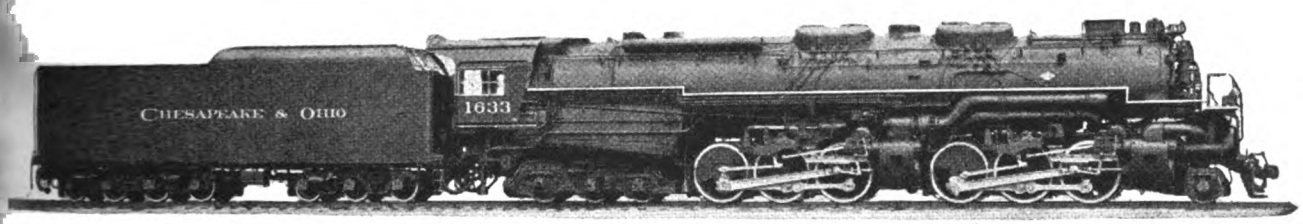
Silicones As Insulating Material†

Early studies and most subsequent investigations of the life of insulation were based on the mechanical durability of insulation. However, they did not emphasize the fact that the thermal behavior of insulation is doubly important because of the effect of aging on moisture resistance. The term "insulation life" implies that after a certain period of aging the useful life of the insulation is expended or that there is a fairly definite end-point. However, life is a variable thing and it is preferable to consider that the actual value of insulation life in the laboratory depends on the tests or criteria used to determine the end-point. Likewise service conditions determine the life in normal operation. The use of very severe tests, or severe operating conditions, will result in a minimum life which may be only a fraction of the maximum life end-point obtained by less rigorous con-

(*Continued on next left-hand page*)

† Abstract of a paper by T. A. Kauppi, Dow-Corning Corporation, and G. L. Moses, Westinghouse Electric & Mfg. Company, presented at the winter technical meeting of the American Institute of Electrical Engineers in New York, January 22-26, 1945.

45 ALLEGHENY TYPE LIMAS



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ditions. Since one of the most important functions of an insulating varnish is to exclude moisture from the electrical windings, it is the opinion of the authors that minimum life of a varnish film may be taken as the point at which a hazardous reduction in moisture resistance occurs.

Silicones are derived from sand, brine, coal and oil as ultimate source materials. However, like certain of the organic high polymers which are said to come from coal, air and water, their synthesis involves a number of steps and a considerable amount of industrial and chemical technology.

Liquid Silicones

One of the first groups of silicone polymers to reach commercial production was the liquid silicones. Several families of these silicone fluids are now available in a wide range of viscosities. They are characterized in general by the properties of low change of viscosity with temperature, low freezing point, unusual inertness and stability to heat. The silicone fluids are finding application as gauge liquids, damping fluids, and in various hydraulic applications. An interesting application is the use of a dilute solution of silicone fluid for treating ceramic surfaces to render them water-repellent. The low dissipation factors of these liquid silicones at elevated temperatures or at high frequencies and their inertness to moisture indicate them for use in liquid filled condensers.

Silicone Resins

Silicone resins are available in two principal types. The first is the insulating varnish type, which is comparable in physical properties to organic oleo-resinous varnishes. The baking temperatures required to cure the currently available silicone varnishes are sufficiently high (200-250 deg. C.) to prohibit their use on organic materials; whereas organic varnishes may be used to coat cotton, paper, silk or wood, silicone varnishes must be used with inorganic materials, such as glass fiber, asbestos, mica or ceramics. The silicone varnish is used to coat glass-served magnet wire and fiber glass cloth, and is used as a binder for building up flexible mica-glass laminated sheet. It is also used as the final impregnating and coating varnish to bind together the individual machine component and water-proof the complete assembly.

The second type of silicone resin corresponds in general behavior to the organic thermosetting resins normally used to make rigid laminated insulating parts. These more recently developed thermosetting silicone resins are being used to bond fibrous glass and asbestos laminated structures, and to impregnate special coils requiring hardness and rigidity.

These two types of silicone resin provide the means for constructing electrical machines which contain no organic materials. The thermal limitations of the complete insulation may be raised to such an extent that thermal aging of the insulation can be ignored in the design process. Factors other than insulation aging will then ordinarily establish the normal operating temperature of the machine at a point well below the temperatures which could be permitted when silicone insulation will be used.

Conclusions

It is important to recognize that the use of silicone resins in electrical insulation need not represent any radical departures from well established purposes. Inorganic components of high temperature insulation have long been available and their characteristics proven. It was the organic bonds, impregnants and surface treatments which limited the thermal endurance of composite insulation containing mica, asbestos and fibrous glass. Silicone resins should be used in combination with these well known materials. References made in this paper to "silicone insulation" imply the substitution of silicone resins for all the organic resins in the better grades of Class B insulation and do not refer to the use of silicone resins as mica substitutes in any way.

Innumerable tests in the laboratory and over fifty years of service experience have demonstrated that thermal aging is the most important single factor in insulation life. Only after such aging occurs does good insulation become vulnerable to the other ills which plague it. Differences in the thermal endurance of various types of insulation have been clearly demonstrated to be a function of the stability of their essential components. Therefore, the recent development of silicone resins promises great improvement in thermal stability of insulation for electrical machines as it improves the weakest link in the insulation system. This improvement properly utilized by designers can be a great asset to the industry. There is no point in increasing operating temperatures unless some useful economic purpose is served, but where electrical machinery must operate at elevated temperatures, silicone resins and high temperature insulation offer a solution to a previously unsolved problem.

Silicone resins have been demonstrated to have thermal stability far beyond that of the best of the conventional organic materials. It therefore appears timely to re-examine the thermal endurance requirements for insulation of electrical machinery, to evaluate the possible advantages from the use of these more heat resistant materials and to seek means for utilizing them for the improvement of electrical machinery where there use is justified. These general problems should be investigated and tests made by as many interested engineers as possible so that a broad perspective is obtained promptly.

Silicones As Lubricants*

A translucent silicone grease of vaseline-like consistency has been developed for use as a lubricant for ignition cables to reduce corona cutting of the insulation and permit easy wiring of ignition harnesses. It is stable to heat and retains its vaseline-like consistency from —40 deg. C. to 200 deg. C. Although it is a soft grease in appearance, it has the unusual property of not melting on exposure to heat. This material also is inert and oxidation resistant. It has no solvent effect upon synthetic insulations or rubber, and tends to prevent the hardening of these materials when heated in contact with air.

Other greases under development are being used for lubricating ball and roller bearings. One type can be used at temperatures as low as —60 deg. F. and has high-temperature stability at least as good as the best available organic greases. Another type of silicone lubricating grease is showing stability in ball bearings several times as great as organic greases at the same temperature.

* Abstract of a paper by T. A. Kauppi, Dow-Corning Corporation, and G. L. Moses, Westinghouse Electric & Mfg. Company, presented at the winter technical meeting of the American Institute of Electrical Engineers in New York, January 22-26, 1945.

(*Turn to next left-hand page*)

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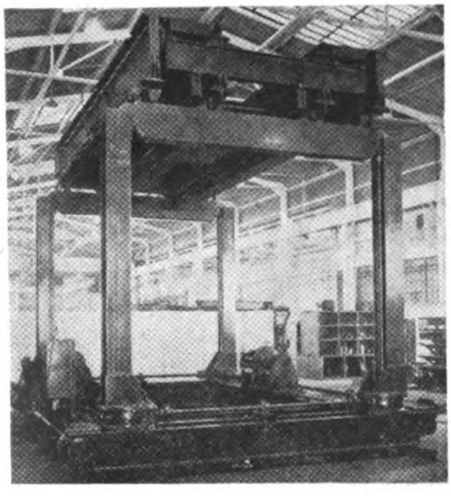
In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

NEW DEVICES

A Large Drop Table

The illustration shows a drop table, made for installation at the Livingston, Mont., shop of the Northern Pacific. This drop table is said to be the largest ever produced by the manufacturer, the Whiting Corporation, Harvey, Ill., both from the standpoint of size and lifting capacity.

The drop table will lift 150 ton and the top is 23 ft. long by 11 ft. 8 in. wide so that either two or three pairs of locomotive driving wheels can be handled at one time.



Whiting 150-ton drop table assembled at the manufacturer's plant preliminary to shipment for installation at the Northern Pacific shops, Livingston, Mont.

There is a small top within the large top, known as the horseshoe design, so that single pairs of wheels can be readily handled. Another feature of this drop table is the provision of twin hoisting units with motors synchronized to operate in unison.

Demagnetizers For Cutting Tools

A line of demagnetizers for removing the magnetism from tools, drills and punches, and thereby preventing excess heat and wear caused by the adherence of magnetic chips, has been announced by the Special Productions Division of the General Electric Company. They are also useful for demagnetizing various machined parts, thus releasing fine adhering particles which often cause severe wear and impair accuracy and appearance. In addition, they can be used to adjust and stabilize the magnetic flux in permanent-flux assemblies for such applications as electric instruments and control devices.

Consisting of a cylindrical air-core coil, mounted in a sturdy stand at a convenient 45 deg. angle, the demagnetizers are available in a 4-in. size, rated 115 volts, 60

The object to be demagnetized is placed inside the unit and withdrawn slowly

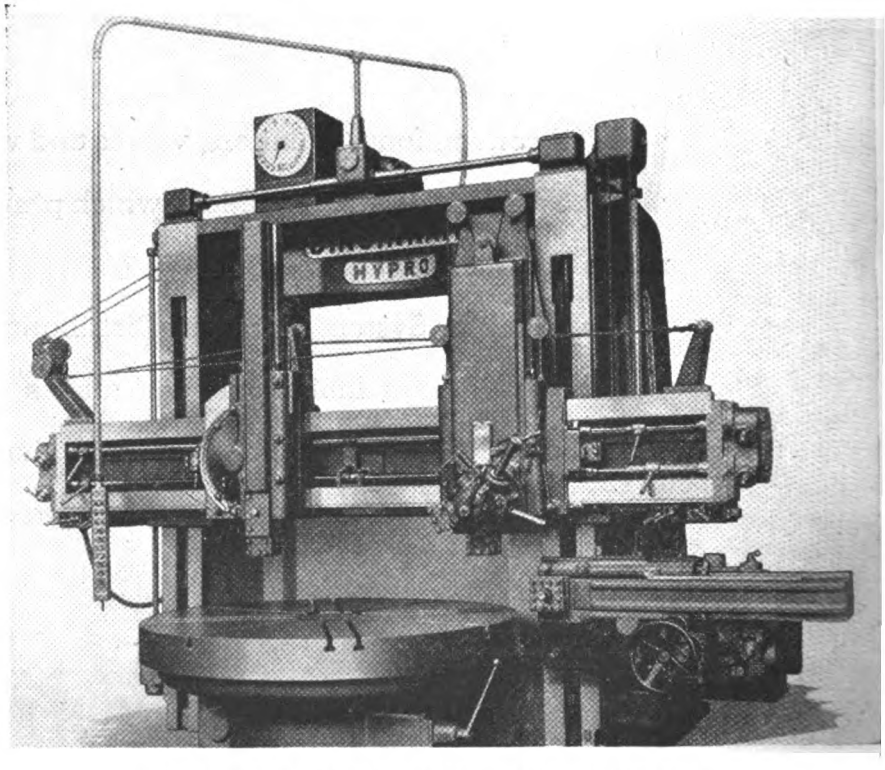
cycles, a.c., and in 8-in. and 12-in. sizes, rated 220/440 volts. Long flexible leads for connection to the power line are furnished with the 4-in. size, while a small connection box behind the coil of the larger sizes accommodates standard electric conduit.

In operation, rated voltage is applied and the material to be demagnetized is either passed directly through the coil or placed in its center and slowly withdrawn about two feet along its axis. At that point the magnetic field is negligible, and the material is then demagnetized.

Push-Button Control Of Boring Mill Speeds

Conventional gear-shift changing of speeds has been replaced by finger-tip speed control by the addition of Hypro drives to the tables of boring mills manufactured by the Cincinnati Planer Company, Cincinnati, Ohio. This gives a complete range of table speeds under cutting loads ordinarily encountered through push-button control from the operator's normal working position. The table need not be stopped nor gears changed. A multi-point, fine-increment motor rheostat used in conjunction with the drive makes table speeds available which are suited to the job being done instead of the compromise speeds which are a part of manually operated gear shifts.

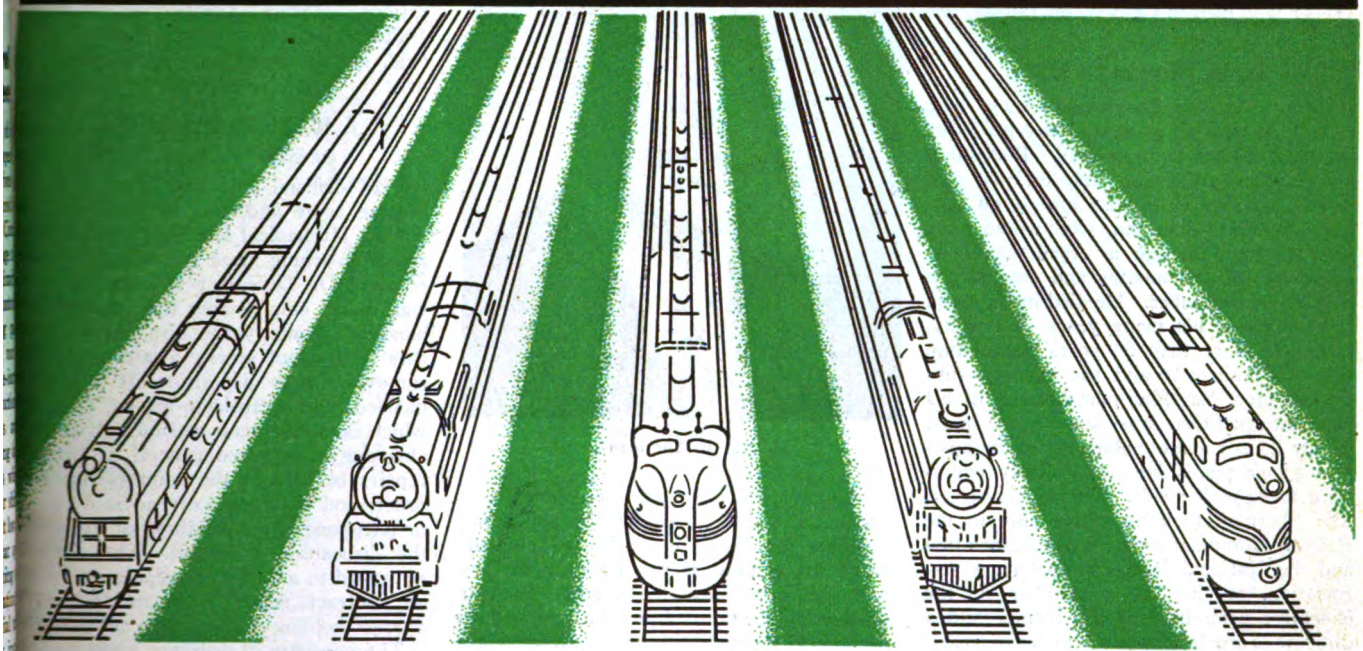
Heavy-cutting requirements at low speeds are met by a suitable back gear operated by a single lever. A fine inching control in both directions of table operation speeds set-up work. A large speed dial mounted on top of the boring mill gives instant indication of table speeds to the operator and pre-set table speeds can be checked at a glance.

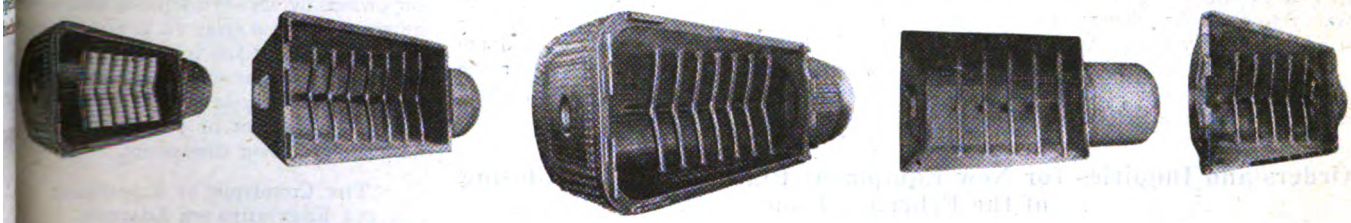


Boring mill equipped with push-button control of table speeds

(Turn to next left hand page)

TO INCREASE Locomotive AVAILABILITY





Besides safeguarding the boiler by assuring a continual flow of water over the center of the crown sheet, Security Circulators have many other advantages that increase Locomotive Availability.

- They reduce honeycombing, flue plugging and cinder cutting.
- They form an ideal support for arch brick and increase the life of the brick.
- They permit the use of a 100% arch and promote better combustion.
- They increase the strength of the firebox structure and tend to prevent boiler distortion.

For these reasons the installation of Security Circulators helps to make locomotives available for continuous operation over longer periods of time and also lowers maintenance costs.

AMERICAN ARCH COMPANY, INC.

NEW YORK • CHICAGO

SECURITY CIRCULATOR DIVISION

NEWS

Prest Appointed Engineer Tests Chilled Wheel Association

SAMUEL C. PREST has been appointed engineer of tests of the Association of Manufacturers of Chilled Car Wheels with offices at Chicago, to succeed George J. Weber who died in Chicago on January 20.

L. B. Sherman Dies

LUCIUS (LOU) BOOTH SHERMAN, who retired on pension as senior vice-president of the Simmons-Boardman Publishing Corporation at Chicago early in 1941, died in Presbyterian Hospital, Chicago, on January 24. Mr. Sherman, who would have been 82 years of age in April, had been ailing for several months and entered the hospital in December. He died in his sleep.

Throughout his many years of activity, including more than 50 years' association with the railroads and the railway supply industry, Mr. Sherman, because of his personal qualities, was one of the most widely known and popular men in the business paper publishing and railway equipment and supply fields. During his career, Mr. Sherman took an active part in the Railway Manufacturers Supply Association and the National Railway Appliances Association, serving as a member of the executive committee of the former and a director of the latter for a number of years. In 1925 he was one of the American Railway Association's delegates to the International Railway Congress at London.

Mr. Sherman was born in Chicago on April 18, 1863, and after attending the

L. B. Sherman

University of Chicago, he immediately chose the selling phase of the publishing business for his career. In 1884 he entered the employ of the Railway Review and soon after rose to business manager of that publication. Later he resigned to become associated with the Railroad Gazette and on November 1, 1901, was promoted to western manager of that publication. In 1908, the Railway Age and the Railroad Gazette were merged under the ownership of Railroad Gazette, Inc., which was succeeded in 1911 by the Simmons-Boardman Publishing Company, of which Mr. Sherman became a vice-president. In 1928, when the Simmons-Boardman Publishing Corporation was organized to take over the Railway Age, the *Railway Mechanical Engineer*, other railway publications, Marine Engineering, American Builder, and other papers in the building field, Mr. Sherman was elected vice-president of the new company.

Orders and Inquiries for New Equipment Placed Since the Closing of the February Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
New York Central	25	4-8-4	American Loco. Co.

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Chicago Great Western	150	Box	Pullman-Standard
Chicago, Milwaukee, St. Paul & Pacific	500[2]	50-ton flat	Co. shops
Colorado & Wyoming	50	Mill type gondolas	Mt. Vernon Car Mfg. Co.
Denver & Rio Grande Western	500	50-ton box	Pressed Steel Car Co.
Fruit Growers' Express Co.	300[3]	40-ton refrigerator	Mt. Vernon Car Mfg. Co.
Illinois Terminal	50	50-ton flat	American Car & Fdry. Co.
Missouri-Kansas-Texas	300[4]	Auto-box	Co. shops
New York Central	1,000[5]	70-ton gondolas	Despatch Shops

FREIGHT-CAR INQUIRIES

Chicago, Rock Island & Pacific	500	Box	
Colorado & Wyoming	50	70-ton gondolas	
Pennsylvania	500[6]	50-ton box	

PASSENGER-CAR INQUIRIES

Road	No. of cars	Type of car	Builder
Canadian National	30	Passenger	

[1] These engines, which are for delivery this year, will be substantially the same as the experimental 4-8-4 type locomotive now being built for the railroad by the American Locomotive Company. The principal difference is in the use of a modified trailer truck, which will permit a further increase in ash-pan volume. The new locomotives will have extra large tenders designed to carry 46 tons of coal and 18,000 gal. of water.

[2] Authorization unconfirmed.

[3] For fourth quarter delivery.

[4] W. P. B. authorization received. M. S. Sloan, president, says the cars will be built in cooperation with the Office of Defense Transportation as the company's share of the 20,000 box cars that the railroads have been requested to purchase and place in service as soon as possible to take care of military demands. The cars will be constructed in the railroad's own shops at Denison, Tex., where 6,000 new and rebuilt cars are reported to have been turned out during the last four years.

[5] For Pittsburgh & Lake Erie.

[6] Inquiry unconfirmed.

A.A.R. Mechanical Division

REPAIRS TO TANK CARS

THE demand for tank cars has again become acute and, late in November, the A.A.R. Mechanical Division, issued a circular letter urging more prompt and adequate repairs. On December 1, a second appeal was issued emphasizing the importance of handling promptly the disposition of tank cars held out of service awaiting advice of car owner as to disposition. It was recommended that petroleum-loaded tank cars which cannot be made satisfactorily serviceable due to required general or extensive repairs be held at the point found in bad order, and the car owner advised by wire or telephone of the condition of the car and the disposition requested. The owner is requested to arrange for repairs at his own or contract repair shop and advise the carrier holding car by wire within 48 hr.

The necessity of ordering materials from car owners by wire or telephone and making shipments without delay via express or truck was also stressed and full co-operation and compliance with the suggestions and instructions was strongly urged in order to expedite the movement of petroleum products during the present emergency.

THE CONDITION OF EQUIPMENT FURNISHED FOR LOADING

Under date of November 20, the A.A.R. worded circular letter dealing with proper loading of cars and selection of proper cars for loading. Cars are apparently continuing to arrive at terminals under load and in unserviceable condition which require repair and in many cases transfer of the lading. Predominating defects on such cars are defective floors and floor stringers, body bolsters broken and corroded, center sills broken and bent or defective, side sills broken, bent or weak and cross bearers broken and corroded.

The Mechanical Division again urges that this matter be handled with all concerned and that every effort be made to insure that cars placed for loading are in proper condition to carry their lading to destination without the necessity of intermediate shopping or transfer.

STANDARD A.A.R., PASSENGER-CAR AXLE ADOPTED

ON September 18, the A. A. R. Mechanical Division sent out to member roads its recommendations for standard dimensions

(*Continued on second left-hand page*)

IT'S A GREAT NEW DAY FOR RAILROADING

All General Motors Diesel locomotives ever built and put in freight, passenger runs, or switching service, excepting the few destroyed in wrecks, during the past ten years are still going strong.

In fact, many of these Diesels are actually better than when built due to improvements that have been made in certain service and replacement parts.

So it's pretty hard to say how durable these General Motors locomotives are since they bid fair to continue indefinitely. And, up to date, there are upwards of 1,800 units of them on 83 of America's major railroads and in heavy industries.

ON TO FINAL VICTORY ★ BUY MORE WAR BONDS

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION
LA GRANGE, ILL.

for A. A. R. passenger-car axles when used with roller bearings, also for axle-centering dimensions. This axle is not a new design but is the standard A. A. R. passenger-car axle with ends modified to accommodate all four types of roller bearings, namely, Hyatt, SKF, Fafnir and Timken. As a result of favorable letter-ballot action, the revised journal dimensions for A. A. R. passenger-car axles when used with roller bearings, also axle-centering dimensions for both plain and roller-bearing axles, have been adopted as standard and recommended practice.

M. B. M. A. 1944 Proceedings Now Available

THE 1944 Proceedings of the Master Boiler Makers' Association are now available through the secretary, A. F. Stiglmeier, 29 Parkwood street, Albany, N. Y.

Duer Receives Stevens Honor Award

JOHN V. B. DUER, assistant to vice-president of the Pennsylvania, was one of nine leading engineers and industrialists to receive a newly established honor award for "notable achievements," at the dinner observing the 75th anniversary of the granting of the charter to Stevens Institute of Technology, held in New York, February 15. Mr. Duer was cited for his accomplishments "in the engineering field of railroad electrification."

Ton-Miles in 1944 1.4 Per Cent Above 1943

AGAIN in 1944 the railroads handled the greatest volume of freight traffic, measured in ton-miles of revenue freight, for any year on record, according to the Association of American Railroads. In that year it amounted to approximately 737,000,000,000 revenue ton-miles, according to preliminary estimates based on reports received from Class I roads. This was an increase of 1.4 per cent above the previous record established in 1943, when the volume amounted to 727,075,495,000 revenue ton-miles. The volume of freight traffic carried by the railroads in 1944 was an increase of 121 per cent compared with 1939.

The volume of freight traffic handled in December, 1944, alone amounted to 57,000,000,000 revenue ton-miles, a decrease of 6 per cent compared with December, 1943.

1944 Equipment Installations

CLASS I railroads put 40,392 freight cars and 938 locomotives in service in 1944, according to the Association of American Railroads. This was an increase of 11,684 cars and an increase of 165 locomotives compared with the number installed in 1943. In 1942 the railroads put 63,009 new freight cars and 712 new locomotives in service.

Of the new freight cars installed in 1944, there were 14,476 plain box, 3,132 automobile, 4,065 gondolas, 16,656 hopper, 1,319 flat, 482 refrigerator, 261 stock cars and one other type of car. The new locomotives installed in 1944 included 329 steam, one electric, and 608 Diesel-electric, compared with 429 steam, 15 electric, and 329 Diesel-electric in 1943.

Distribution of Horsepower of Total Diesel Locomotives in Railway Service

(AS ESTIMATED BY THE RAILWAY AGE)

	Freight Locomotives		Passenger and Comb. Pass. and Frt. locomotives		Totals	
Horsepower	No.	Total hp.	No.	Total hp.	No.	Total
5,400	191	1,031,400	11	59,400	202	1,090,800
4,050	1	4,050	1	4,050	2	8,100
3,600	...	.....	2	7,200	2	7,200
2,700	6	16,200	8	21,600	14	37,800
2,000	...	.....	220	440,000	220	440,000
1,800	...	.....	31	55,800	31	55,800
1,200	...	.....	7	8,400	7	8,400
1,000	9	9,000	7	7,000	16	16,000
600	1	600	...	.....	1	600
380	8	3,040	...	.....	8	3,040
Less than 380	2	500	...	.....	2	500
Total road locos.	218	1,064,790	287	603,450	505	1,668,240
Switching locos.		(Averaging 800 hp. per locomotive)			2,010	1,610,438
Total road and switch locos.					2,515	3,278,678

Note:—384 Diesel locomotives of 268,840 total horsepower are estimated to be in service on switching and terminal companies and on Class II and III railroads.

Class I railroads on January 1, 1945, had 36,597 new freight cars on order. On the same date last year they had 35,737 on order. The former figures included 19,210 plain box, 1,376 automobile box, 4,074 gondolas, 8,915 hoppers, 2,183 refrigerator, 239 stock, and 600 flat cars.

Miscellaneous Publications

"CRUCIBLE MELTERS' HANDBOOK."—Crucible Manufacturers' Association, 90 West street, New York 6. An 18-page pamphlet, illustrated. A treatise on crucible furnaces and on the storing, handling, and use of crucibles. Shows actual installations and contains a table of standard sizes of crucibles and their dimensions; a table of melting points of various metals; a table of the composition of steam or red brass alloys, and a tabulation of the approximate composition and physical properties of aluminum sand casting alloys.

◆

"METAL QUALITY."—Drop Forging Association, 605 Hanna Building, Cleveland, Ohio. Forty-page booklet. Describes and illustrates how "hot working" improves properties of metal. Deals broadly with characteristics of forging materials and, by means of halftone illustrations and diagrams, gives in not-too-technical language an understanding of how steel gains in strength and toughness, step by step, progressively through hot-working operations, from ingot to finished forging. The booklet then shows how "forging quality" steel is still further improved by hot-working.

◆

"SHOT PEENING AND THE FATIGUE OF METALS." By H. F. Moore, published by American Foundry Equipment Company, 555 South Byrkit street, Mishawaka, Ind. Twenty-four-page booklet. Contains an interpretation and analysis of many months' laboratory research on the subject of shot peening and the fatigue of metals. Covers types of structural damage of metals; how shot peening increases resistance to plastic distortion; the origin of fatigue cracks; the effects of cold working; measurement of shot peening intensity; examples of increased fatigue life from shot peening, etc. Illustrated with microphotographs, charts and tables.

Railroads also had 468 locomotives on order on January 1, this year, which included 66 steam, two electric, and 400 Diesel-electric locomotives. On January 1, 1944, they had 955 locomotives on order which included 339 steam and three electric and 613 Diesel-electric.

Parmelee Succeeds Gormley in War Manpower Job

DR. JULIUS H. PARMELEE, director of the Bureau of Railway Economics, has been appointed an alternate management member of the War Manpower Commission's Management-Labor Policy Committee. He will serve as alternate for R. Conrad Cooper, assistant vice-president of the Wheeling Steel Corporation, succeeding M. J. Gormley, executive assistant of the Association of American Railroads, who retired on December 31.

Material Handling Institute

LAWRENCE J. KLINE, of the Mercury Manufacturing Company, Chicago, has been elected president of the newly formed Material Handling Institute. J. Faulkner Thomas of the Thomas Truck & Caster Co., Keokuk, Iowa, has been elected vice-president and Walter S. McCann, acting secretary and treasurer. The institute is a non-profit organization designed to serve as a medium for the exchange of facts and information relating to industrial material handling and the activities of manufacturers in that field.

Eastern Car Foremen Elect Officers for 1945

AT the annual meeting of the Eastern Car Foremen's Association, held on January 12 in the Engineering Societies building, 29 West Thirty-ninth street, New York, the following officers were elected for the coming year: President, K. H. Carpenter (superintendent car department, Delaware, Lackawanna & Western); first vice-president, G. H. Massy (superintendent, motive power, Central of New Jersey); second vice-president, P. J. Hogan (superintendent car inspection and maintenance New York, New Haven & Hartford); treasurer, T. G. Case (general car foreman, New York Central), and secretary, Wilson P. Dizard (American Car and Foundry Company).

Supply Trade Notes

OHIO BRASS COMPANY.—The San Francisco, Calif., office of the Ohio Brass Company, Mansfield, Ohio, has been moved to 582 Market street.

◆

STANDARD RAILWAY EQUIPMENT COMPANY.—*Arthur A. Frank,* president of the Standard Railway Equipment Company, Chicago, has been elected chairman of the board and will continue as president of the Standard Railway Equipment Manufacturing Company. *A. A. Helwig,* vice-president of the Standard Railway Equipment Company, at Chicago, has been elected president to succeed Mr. Frank. *D. R. Arnold,* vice-president of the Standard Railway Equipment Company, at New York, has been appointed senior vice-president at New York, and *R. G. Sonquist* and *J. E. Vaughn,* assistant vice-presidents, at New York and Chicago, respectively, have been named vice-presidents.

◆

ELECTRIC STORAGE BATTERY COMPANY.—*Lester E. Lighton,* manager of the department of development and design of the Electric Storage Battery Company, Philadelphia, Pa., has been elected vice-president in charge of engineering. Mr. Lighton is a graduate of Bucknell University (1920). He began his career on the sales staff of the Electric Storage Battery Company at Detroit, Mich., in that year and became manager of automotive manufacturers sales, with headquarters in Philadelphia, in 1925. He was assigned to the department of development and design as assistant to the manager in 1935 and was appointed manager of that department in 1940.

◆

GENERAL RAILWAY SIGNAL COMPANY.—*Sidney George Johnson,* vice-president in charge of sales of the General Railway Signal Company, with headquarters in New York, has retired at his own request from active charge of sales. *Winthrop K. Howe,* vice-president in charge of engineering, with offices at Rochester, N. Y., has retired, after 44 years of service with the company, but will continue in an advisory capacity. *Herbert W. Chamberlain,* assistant to the president, with offices in New York, has been appointed vice-president in charge of sales. *Charles S. Bushnell,* train-control engineer, has been promoted to the position of chief engineer. *Percy W. Smith,* sales engineer, reporting to the New York office, has been appointed resident manager of the New York office. *Wilbur D. Cloud,* resident manager of the New York office, has been appointed eastern manager. *Arthur S. Heimbach,* sales engineer in the Chicago office, has been appointed resident manager of the Chicago office. *William H. Bennett,* resident engineer at San Francisco, has been appointed sales engineer with headquarters in New York. *Oscar S. Field,* senior designing engineer, with offices at Rochester, N. Y., has been appointed director of engineering and research.

NATIONAL LOCK WASHER COMPANY.—*Esty Foster,* executive vice-president, has been elected president and a director of the National Lock Washer Company, Newark, N. J., to succeed *Cyrus H. Loutrel,* who has become chairman of the board, a newly created office. Mr. Foster joined the company as executive vice-president in May, 1944, from Ford, Bacon & Davis, Inc., engineers, of New York. For three years he had served in Washington on leave of absence as operations adviser and in other positions with the Office of Production Management, the War Production Board, and the combined Production and Resources Board. He was formerly a member of the faculty of the Graduate School of Business Administration, Harvard University, and a special engineer in the office of the assistant to the president and of the inspecting engineer of the New York Central. *Arthur W. Preikschat* and *Gilbert E. Webster,* vice-presidents, have been elected directors of the company.

◆

CINCINNATI MILLING AND GRINDING MACHINES, INC.—Customers of the Cincinnati Milling Machine Company and Cincinnati Grinders Incorporated in the Baltimore, Md., and Washington, D. C., territories are now being served through their sales subsidiary, Cincinnati Milling and Grinding Machines, Inc., located at Fifteenth and New York avenues, N. W., Washington, D. C. *E. Reiniger,* factory specialist, is now associated with *C. W. Burgess* who is located in the Washington office. Mr. Reiniger also continues to serve the Philadelphia, Pa., territory of the W. E. Shipley Machinery Company. *Clarence A. Thumm,* who was previously the company's agent in the Baltimore and Washington areas, has retired.

◆

AMERICAN ROLLING MILL COMPANY—*Roy P. Tooke,* of the general engineering staff of the American Rolling Mill Company, has been appointed assistant chief engineer of the company's general engineering division. In the sheet and strip sales department, the following promotions have been announced. *Murray B. Wilson,* formerly New York district sales manager, has been appointed Dayton, Ohio, district sales manager to succeed *Edson D. Dronberger. W. B. Quail,* formerly New York district manager of the American Rolling Mill Railroad Sales Company, succeeds Mr. Wilson as New York district manager of sheet and strip sales. *Mitchell G. Duncan,* who has been connected with the company's St. Louis, Mo., office for the past 12 years, has been transferred to the Detroit, Mich., office as a salesman and *Fred Mayhew,* of the company's home sales office and a former member of the St. Louis office, succeeds Mr. Duncan at St. Louis. *Robert L. Wells, Jr.,* a salesman in the Minneapolis, Minn., office, has been transferred to the Dallas, Tex., office.

AMERICAN WELDING & MANUFACTURING CO.—*Edward C. Fales,* assistant to the president of the American Welding & Manufacturing Co., Warren, Ohio, has been elected vice-president of the company.

◆

METAL & THERMIT CORPORATION.—*John B. Tinnon,* vice-president in charge of sales and *Walton S. Smith,* vice-president in charge of production, have been elected to the board of directors of the Metal & Thermit Corporation.

◆

CRANE COMPANY.—*R. E. Penny,* manager of the Jacksonville, Fla., branch of the Crane Company, has been appointed manager at Los Angeles, Cal., to succeed *D. D. Updegraff,* who has resigned. *L. R. Bauer,* manager at Brooklyn, N. Y., and New Haven, Conn., succeeds Mr. Penny at Jacksonville, and *J. J. Murray,* a planning department analyst at the Chicago works, has been appointed manager at New Haven. *O. F. Woodyard,* former manager at Little Rock, Ark., has been appointed manager in Memphis, Tenn., to succeed *F. A. Duncan,* who has retired, and *A. C. Gribble,* a salesman at the Houston, Tex., branch, has been appointed manager at Little Rock.

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—A several-million dollar modernization and construction program to prepare its plants for the speedy production of railway equipment, including newly designed cars embodying revolutionary concepts of passenger accommodations, has been announced by the Pullman-Standard Car Manufacturing Company.

The program, as revealed by Wallace N. Barker, vice-president, embraces all six of the company's plants and includes new construction, installation of new equipment, renovations of buildings and machinery, alterations for improving working conditions and rearrangement of facilities for the most efficient operation. The Chicago and Worcester, Mass., plants will be revamped for the resumption of passenger-car construction, with the latter also scheduled for additional changes and new machinery for the better manufacture of modern transit equipment.

The company's four freight car plants in Hammond, Ind., and Michigan City, Butler, Pa., and Bessemer, Ala., presently occupied with war contracts for mortars, heavy artillery, shells and freight cars for the domestic railroads and for the Army are scheduled for alterations to expedite ultimate production of domestic and foreign freight cars.

To help provide employment the company is prepared, as soon as it gets the green light, to produce wholly new types of cars that are expected to aid the railroads in retaining a substantial part of their heavy wartime passenger traffic by raising travel comfort to new heights.

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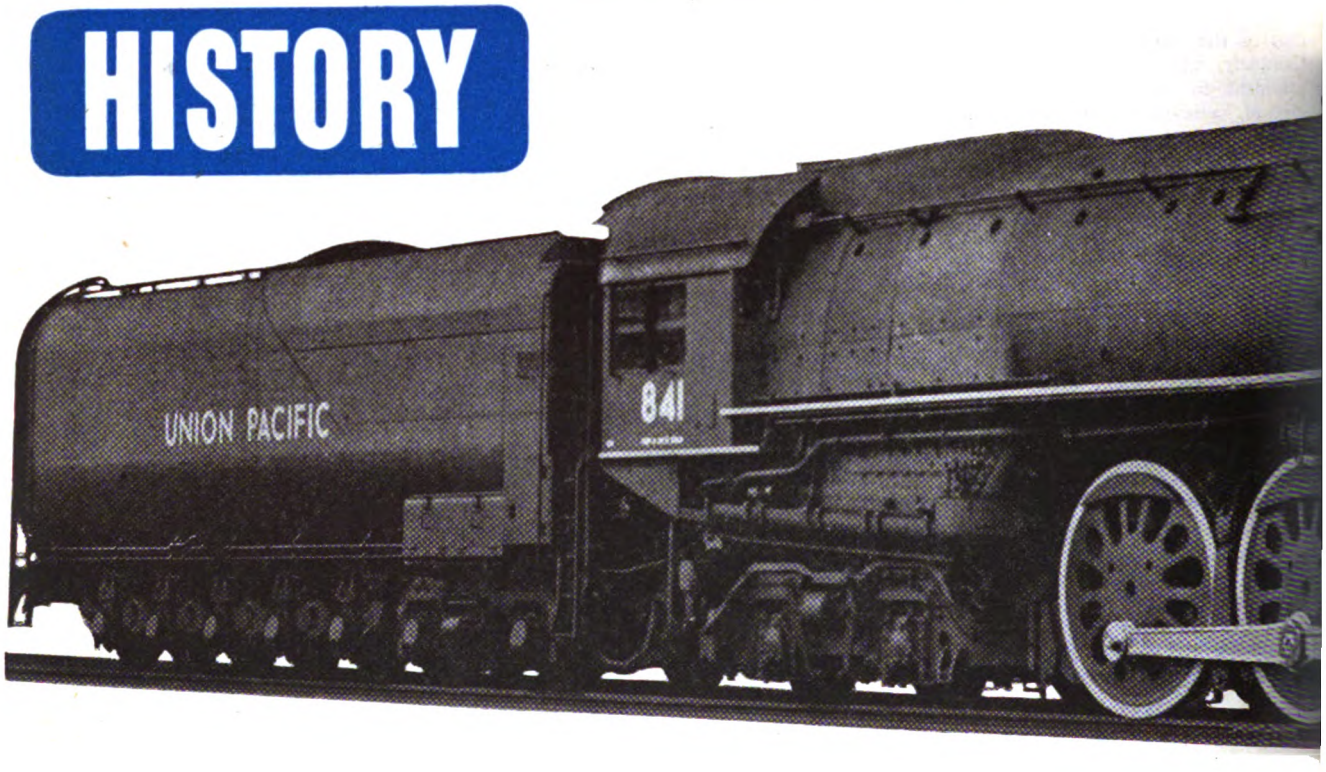
LOCOMOTIVES THAT ARE MAKING HISTORY



TEN of the powerful, high-speed 4-8-4's have just been delivered by American Locomotive to the Union Pacific.

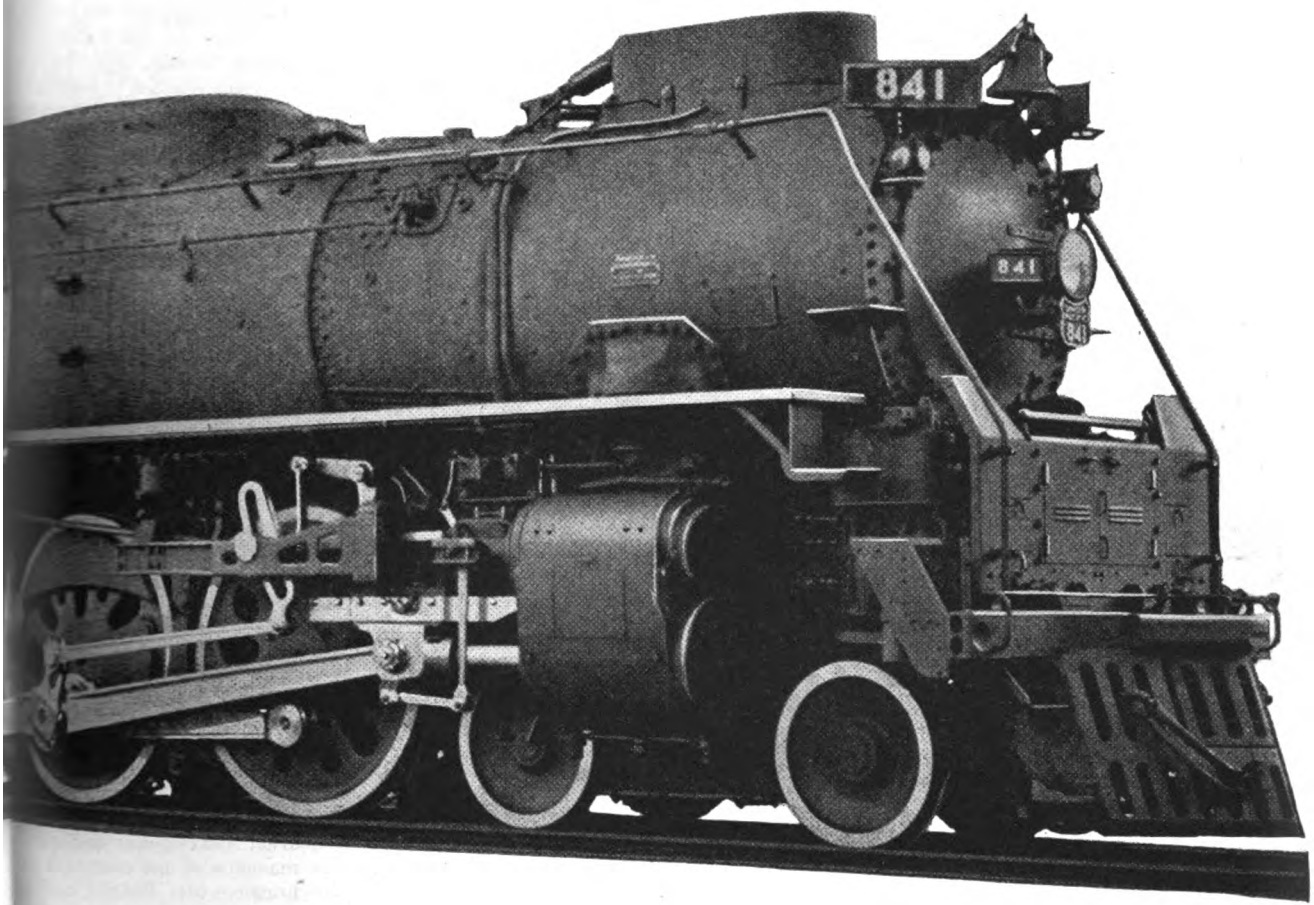
Forty-five of these locomotives are now operating on fast passenger schedules, pulling 16 to 22 car trains to their destinations, on time.

The first of these 4-8-4's was delivered in 1937. Since that time, these passenger locomotives have, through their successful operation, become part of Union Pacific's locomotive backbone.

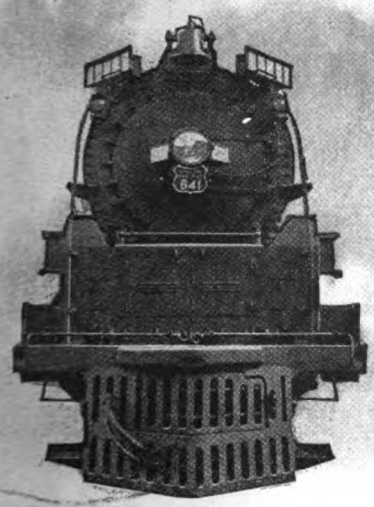
Here are the "SPECS":

Weight on Drivers	270,300 lbs.
Weight of Engine	490,700 lbs.
Cylinders	25 x 32 ins.
Diameter of Drivers	80 ins.
Boiler Pressure	300 lbs.
Tractive Power	63,800 lbs.
Capacity (Water)	23,500 gals.
Capacity (Fuel)	25 tons

Locomotive designs developed by American Locomotive Company have been, are, and will continue to be powerful factors in American railroad operating efficiency and economy.



● *Unsurpassed for the Job because Built for the Job*



American Locomotive

NEW YORK

OKONITE COMPANY.—*A. L. McNeill* has been appointed manager, Chicago district, of the Okonite Company and will direct the company's insulated wire and cable sales in the middle western territory extending from Ohio to the Rocky Mountains. Mr. McNeill was previously manager of the railroad department in that territory. He began his career with the Alton in 1900 and from 1908 to 1911 was chief clerk in the purchasing department. Following the temporary consolidation of the Alton, the Minneapolis & St. Louis, the Iowa Central and the Toledo, St. Louis & Western, Mr. McNeill was appointed assistant purchasing agent for this group in 1911. He joined the Central Electric Company, Okonite's agent in Chicago, in 1913 and served as manager of railroad sales until 1925 when he joined the Okonite organization which established its own Chicago district office at that time. *E. H. McNeill,* formerly manager of the

A. L. McNeill

power and light department, has been appointed assistant manager, Chicago district, and *Harry D. Pierce* has been appointed office sales manager. Both A. L. McNeill and E. H. McNeill will continue to work with the railroads and public utilities.

◆

AIR REDUCTION SALES COMPANY.—*H. F. Henriques,* formerly sales manager of the north central division, has been appointed general sales manager of the Air Reduction Company. *J. J. Lincoln,* formerly sales manager of the south central division, has been appointed director of sales services. *C. M. Bloodgood,* sales manager of the Pacific Coast division, has been appointed assistant to the vice-president in charge of sales. All have headquarters at the company's New York offices. *H. P. Etter,* manager of the Los Angeles, Calif., district, has been appointed sales manager of the Pacific Coast division with headquarters in San Francisco, Calif.

◆

AMERICAN CAR AND FOUNDRY COMPANY.—*W. E. Olds* has been appointed sales agent for the American Car and Foundry Company, with headquarters in the company's Chicago office. Mr. Olds is a graduate of Wisconsin University (1923). He served overseas for 16 months with the U. S. Engineers' Corps in the first World War. He joined the Gary, Ind., works of the U. S. Steel Corporation in 1923 and was employed in that company's St. Paul, Minn., sales office in 1924-25. He subsequently worked in the investment field until 1936. Since then he has served successively as sales engineer for the Petti-

W. E. Olds

bone, Mulliken Corporation and the Gustin-Bacon Manufacturing Company, and, until recently, as western manager, railway division, for the Elastic Stop Nut Corporation.

◆

GENERAL ELECTRIC COMPANY.—*F. H. Craton* has been appointed assistant manager of the General Electric Company's

F. H. Craton

transportation division. For the present he will continue also as manager of the industrial haulage division. Mr. Craton is a graduate of Syracuse University. He joined the General Electric Company's factory management course in Schenectady, N. Y., in 1924; entered the railway equipment engineering division at the Erie, Pa., works in 1926; was transferred to the transportation engineering division in 1930, and was appointed manager of the industrial haulage division in August, 1941. Mr. Craton has served in an executive capacity on the War Production Board and is now chairman of the mining and industrial locomotive section of the National Electrical Manufacturing Association.

◆

COOPER-BESSEMER CORPORATION.—*A. M. Buxton,* of the Tulsa, Okla., office of the Cooper-Bessemer Corporation, has been appointed assistant sales manager, with headquarters at Mount Vernon, Ohio. In addition to sharing responsibilities of the general sales manager, Mr. Buxton will direct the company's oil and gas field sales.

◆

UNITED STATES STEEL CORPORATION.—The corporation plans to spend at least $50,000,000 in post-war improvements to its Gary, Ind., mills, Irving S. Olds, chairman, has disclosed. This program, he said, embraces improvements and additions to raw material-handling equipment, renovation of blast furnaces and machinery, improvements to facilities for the manufacture of wheels and axles, an enlargement of the sheet and tin mill and a rebuilding and modernization of the bridge and structural steel fabricating plant.

◆

PAXTON DIESEL ENGINEERING COMPANY.—*George T. Badger* has been appointed chief sales engineer of the Paxton Diesel Engineering Company, a newly formed subsidiary of the Paxton-Mitchell Company at Omaha, Neb., according to an announcement by James L. Paxton, Jr., president of both companies. Mr. Badger is an engineering graduate of Purdue University. He comes to his new position after 13 years with the Minneapolis-Honeywell Regulator Company. For the past five years he had been sales engineer in charge of railway controls market development and previously was manager of the company's Indianapolis branch. Mr. Badger, as chief

George T. Badger

sales engineer, will direct market development of Diesel specialties and parts manufactured by the Paxton Diesel Engineering Company. The company will also maintain a Diesel repair service for railroads and other operators of Diesel engines.

Army-Navy E Awards

American Steel & Wire Company, Worcester, Mass. Third renewal.

Automatic Transportation Company, Chicago. Fourth award.

Briggs Clarifier Company, Washington, D. C. Third award.

Chain Belt Company, Milwaukee, Wis. Fourth award.

General Cable Corporation, Rome, N. Y. Fourth award.

INDEPENDENT PNEUMATIC TOOL COMPANY.—*W. H. Brewer,* general manager of the Aurora, Ill., factory of the Independent Pneumatic Tool Company, has retired after 36 years of service in the plant.

◆

SPRING PACKING CORPORATION.—*John D. Herr* has been elected vice-president of the Spring Packing Corporation, Chicago. Mr. Herr was born in Altoona, Pa., and, after serving the Pennsylvania in various capacities, entered the employ of the Spring Packing Corporation in 1922.

◆

NATIONAL BATTERY COMPANY.—Effective March 1, 1945, *H. G. Barnes* will succeed *Herbert King* as vice-president in charge of sales of the National Battery Company and its Gould Commercial Division. Mr. Barnes has been associated with the National Battery Company since 1940, when he was appointed vice-president and general manager of National's Gould Com-

H. G. Barnes

mercial Division with headquarters at Depew, N. Y. Prior to his present connection, Mr. Barnes was president of the Motor Power Equipment Company, St. Paul, Minn. In his new capacity he will make his headquarters at the general offices in St. Paul. Mr. King, whose connection with National Battery Company dates from 1933, plans to enter business in San Francisco.

◆

KENNAMETAL, INC.—*Robert B. Thomson* has been appointed tool engineer of Kennametal, Inc., with headquarters at Latrobe, Pa. Mr. Thomson will be assistant to the chief engineer and will be responsible for subcontracting.

◆

AMERICAN HOIST & DERRICK COMPANY.—*Frederic Crosby,* president of the American Hoist & Derrick Co., St. Paul, Minn., has been elected chairman of the board and has been succeeded by *Harold O. Washburn,* vice-president and treasurer. *R. E. Ljungkull,* chief engineer, has been elected vice-president of engineering; *D. B. Botkin,* superintendent of production, has been elected vice-president of manufacturing; and *S. M. Hunter,* manager of sales, has been elected vice-president of sales. *J. F. Bishop* has been named secretary and assistant treasurer and *R. J. Henry* has been appointed assistant secretary.

COPPERWELD STEEL COMPANY.—*Clyde S. Sowards* has returned to the Copperweld Steel Company, Glassport, Pa., after a 2½ year leave of absence during which he served in the U. S. Army, holding the rank of captain at the time he reverted to an inactive status. He will take up his former territory for Copperweld, the northern portion of the South Atlantic states.

◆

GRIFFIN WHEEL COMPANY.—*Charles E. Barnes,* sales agent of the Griffin Wheel Company, Chicago, has been appointed gen-

Charles E. Barnes

eral sales manager and *Edward Q. Sylvester,* sales engineer at Boston, Mass., has been appointed assistant to the president. Both will have headquarters at Chicago. *Charles E. Barnes* entered the employ of the Griffin Wheel Company in 1937 and from 1939 to 1943 served as sales agent at Kansas City, Mo. In the latter year, he was transferred to the general sales department at Chicago.

Edward Q. Sylvester entered the employ

Edward Q. Sylvester

of the company in 1940 as sales engineer at Boston.

Obituary

CHARLES S. KNAPP, engineer of valuation of the Pullman Company, died on January 30. Mr. Knapp was a graduate of the Washington University of St. Louis, Mo. He entered railway service in 1898 as a draftsman of the Pullman Company at Chicago. He left the company in 1901 and returned two years later as a mechanical inspector. In 1905 Mr. Knapp was appointed assistant mechanical superintendent, with headquarters at Chicago; in 1914, engineer of tests; in 1916, assistant chief engineer, and on January 1, 1921, engineer of valuation.

◆

GURDEN H. HAMILTON, vice-president of the Glidden Company, died of a heart attack on February 7 while attending a company meeting in Cleveland, Ohio.

◆

JOHN F. SHANAHAN, of the New York sales department of the Superheater Company, died January 26. Mr. Shanahan, who was 59 years of age, received his railroad training in the motive-power department of the Erie. He joined the New York sales and service departments of the Superheater Company in April, 1917.

◆

ROBERT F. CARR, chairman of the board of the Dearborn Chemical Company, Chicago, died in Passavant Hospital, Chicago, on January 22 after an illness of three weeks. At the time of his death Mr. Carr was a director of several other companies

Robert F. Carr

in Chicago including Wilson & Co., the Continental Illinois Bank & Trust Co., the Peoples Gas Light & Coke Co., and the Chicago & Eastern Illinois. Mr. Carr was born at Argenta, Ill., on November 21, 1871, and was a graduate of the University of Illinois in 1893. In the following year he entered the employ of the Dearborn Chemical Company and served successively as secretary and vice-president and general manager until 1907 when he was elected president. In January, 1944, he was elected chairman of the board. During World War I he was a major on the general staff of the Purchase, Storage and Traffic division of the U. S. Army.

◆

FRANK L. GIBBONS, manager of sales of the alloy division of the Carnegie-Illinois Steel Corporation, Chicago, died in Winnetka, Ill., on January 19. Mr. Gibbons had been associated with Carnegie-Illinois since February 1, 1936. Previously he had been vice-president of the Timken Company, Canton, Ohio, and before that was with the Republic Steel Corporation, Cleveland. Mr. Gibbons was 53 years of age. He was educated at the Carnegie Institute of Technology.

(Turn to second left-hand page)

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Personal Mention

General

GEORGE H. POLLARD has been appointed mechanical engineer of the Missouri Pacific, with headquarters at Palestine, Tex.

A. O. GEERTZ has been appointed fuel engineer of the Pennsylvania, with headquarters at Philadelphia, Pa.

C. B. COTTON, supervisor of motor-car equipment of the Chicago & Northwestern at Chicago, has retired.

K. F. NYSTROM, mechanical assistant, chief operating officer, of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Milwaukee, Wis., has been named chief mechanical officer. This is a change of title.

FLOYD R. MAYS has retired as vice-president of the Illinois Central, with headquarters at Chicago. Mr. Mays was born at Crockett, Va., on August 28, 1879, and entered railway service at the age of 15 years as a machinist apprentice on the Norfolk & Western. He subsequently became a machinist and as such served on the Southern at Salisbury, N. C., and Selma, Ala. On July 31, 1901, he became a machinist on the Yazoo & Mississippi Val-

Floyd R. Mays

ley (now part of the Illinois Central) at Memphis, Tenn., and from October, 1901, to 1917 served successively as locomotive fireman, locomotive engineman, instructor on transportation rules, traveling engineer, assistant trainmaster and trainmaster. On August 15, 1917, he was appointed superintendent of the New Orleans division, with headquarters at Vicksburg, Miss.; on April 1, 1923, he was transferred to the Ilinois division of the Illinois Central, with headquarters at Champaign, Ill.; on January 1, 1926, became general superintendent of the Y. & M. V., with headquarters at Memphis, and on October 1, 1929, was appointed general superintendent of motive power of the I. C., with headquarters at Chicago. His title was later changed to general superintendent of equipment. In April, 1939, he became general manager, and on January 1, 1940, was elected vice-president.

HARVEY C. GRIFFITH, electrical engineer of the Pennsylvania at Philadelphia, Pa., has been appointed assistant chief engineer —traction, communications, signals—with headquarters at Philadelphia. Mr. Griffith was born at New Enterprise, Pa., on June 17, 1890, and received his degree in elec-

Harvey C. Griffith

trical engineering from Lehigh University in 1914. He entered the service of the Pennsylvania in February, 1915, as a draftsman in the office of the electrical engineer at Altoona, Pa., and was transferred to Philadelphia in 1916, working in various capacities on the Paoli and Chestnut Hill electrifications. In 1923 Mr. Griffith was furloughed to Gibbs & Hill, consulting engineers, to serve as construction superintendent during the installation of substations and lines for power supply to the West Jersey & Seashore (now the Pennsylvania-Reading Seashore Lines), and the closing down of a company-owned power plant at Westville, N. J. Upon completion of this work he returned to the electrical engineer's office of the Pennsylvania as foreman. On May 1, 1927, he was appointed assistant engineer, with the special assignment of preparing an electrification study for the eastern territory of the Pennsylvania. When this work was completed he again returned to the electrical engineer's office, becoming assistant electrical engineer in May, 1929, and actively engaging in the New York-Washington electrification project. On July 1, 1935, Mr. Griffith was appointed electrical engineer at Philadelphia.

DR. WILLIAM M. BARR, chief chemical and metallurgical engineer of the Union Pacific at Omaha, Neb., has been appointed research and standards consultant, with headquarters at Omaha. Dr. Barr was born at West Union, Iowa, on August 26, 1878, and is a graduate of the University of Iowa (1902). He also attended Grinnell College and the University of Penn-

Dr. William M. Barr

sylvania, from the latter of which he received the degree of Doctor of Philosophy in 1908. Dr. Barr first entered railway service in May, 1916, as a consulting chemist in the employ of the Union Pacific, later becoming chief chemist and metallurgical engineer.

J. J. DALY, master mechanic of the Nebraska division of the Union Pacific at Council Bluffs, Iowa, has been appointed superintendent of motive power and machinery, with headquarters at Omaha, Neb.

D. S. NEUHART, superintendent of motive power and machinery, eastern district, of the Union Pacific at Omaha, Neb., has been appointed assistant general superintendent of motive power and machinery, with headquarters at Omaha. This is a newly created position.

Military Citations and Awards

LEGION OF MERIT

Lt. Col. Howard G. Hill, Port Arthur, Tex. Former mechanical engineer, Southern Pacific. For the performance of "outstanding services in southern Sicily where, from August 1 to August 18, 1943, he was general manager of the U. S. Military Railway.

BRONZE STAR MEDAL

Lt. Col. Miles G. Stevens, Somerset, Ky. Formerly master mechanic, Southern. For "meritorious service in connection with military operations during the period from December, 1943, to July, 1944." Reported by headquarters, European Theater of Operations.

ORDINE DELLA CORONA D'ITALIA

(Conferred by the Italian government "in appreciation of their services in the rehabilitation, reconstruction and operation of Italian State Railways.")

Brig. Gen. Carl R. Gray, Jr., Director General, First Military Railway Service. Grand Ufficiale Class.

Col. Frank R. Hosack, superintendent motive power, Missouri Pacific, St. Louis, Mo. Commendatore with Gold Crown.

Lt. Col. John J. Daugherty, former shop superintendent, Southern Pacific, Houston, Tex. Ufficiate with Silver Crown.

M. W. McMahon has been appointed locomotive appliances inspector of the New York Central System with headquarters at New York.

Harry L. Nancarrow has been appointed general manager of the Eastern Region of the Pennsylvania, with headquarters at Philadelphia, Pa. Mr. Nancarrow was born at Jersey Shore, Pa., on January 13, 1897, and received his bachelor's degree in mechanical engineering from Bucknell University in 1920. He then entered railroading as a draftsman in the employ of the Pennsylvania at Harrisburg, Pa., and in 1921 was appointed a special apprentice at the Altoona works. After

Harry L. Nancarrow

serving briefly as a motive-power inspector at Altoona he became gang foreman at Cleveland, Ohio, in September, 1924, and assistant foreman in 1926. Mr. Nancarrow was appointed assistant master mechanic at Akron, Ohio, in March, 1927, and master mechanic of the Erie and Ashtabula division at New Castle, Pa., in May, 1928. He subsequently served as master mechanic on the Baltimore, Atlantic, Schuylkill, and Philadelphia Terminal division and in September, 1936, was appointed superintendent of the Logansport division at Logansport, Ind. He transferred to the Buffalo division in January, 1938; in May, 1939, was appointed superintendent, passenger transportation, eastern region, with headquarters at Philadelphia; in January, 1940, became superintendent of the Pittsburgh division, and one year later was appointed general superintendent of the Lake division. On February 16, 1942, Mr. Nancarrow became general manager, western region, at Chicago, and is now general manager, eastern region.

Joseph A. Andreucetti, who has been appointed chief electrical engineer of the Chicago & North Western with headquarters at Chicago, as noted in the February issue, is a past president of the Railway Electrical Pioneers Club; former secretary-treasurer of the Association of Railway Electrical Engineers, and is the present secretary of the Electrical Section, Mechanical Division, A. A. R. The statement regarding Mr. Andreucetti's connections with these associations was incorrect in the February issue.

J. R. Frohoff, master mechanic of the Colorado division of the Union Pacific at Denver, Colo., has been appointed superintendent of motive power and machinery of the northwestern district, with headquarters at Albina, Ore.

Master Mechanics and Road Foremen

Harry Graham Dugan, who has been appointed master mechanic of the Toledo Terminal Railroad at Toledo, Ohio, as noted in the February issue, was born on August 31, 1894, at Jeffersonville, Ind. During high-school vacations he worked on ferry and excursion boats on the Ohio River. He completed his high-school education in 1913 and in November of that year entered the service of the Pennsylvania as a machinist apprentice. He became a machinist on April 1, 1916, subsequently serving as engine inspector, air-brake inspector, and assistant foreman. He was in Naval aviation during the first World War, from November, 1917, to September, 1919. Mr. Dugan then returned to the Pennsylvania as an engine inspector.

H. G. Dugan

He attended Purdue University from 1920 to 1924 and became a special apprentice in the employ of the New York, Chicago & St. Louis in 1924. He then served successively as enginehouse foreman, back shop foreman, and general back shop foreman, at Stony Island, Ill.; Bellevue, Ohio; Conneaut, Ohio; Buffalo, N. Y., and Lima, Ohio.

Porter Clay Branch, who has been appointed master mechanic of the Southern at Ludlow, Ky., as announced in the February issue, was born on October 17, 1896, at Shelby, Ala. From 1904 until 1911 he attended public school at Birmingham, Ala., and in September, 1913, became a drill press operator in the employ of the Southern at Birmingham. He was a machinist apprentice at Birmingham from December, 1913, until December, 1917, when he entered the service of the U. S. Army. He served overseas from July, 1918, until early in 1919. In February, 1919, he returned to the Southern as a machinist, leaving in June, 1919, to go with the St. Louis-San Francisco as a machinist at Birmingham. He returned to the Southern in December, 1922; became assistant enginehouse foreman on March 2, 1934; erecting shop foreman on June 16, 1938; general foreman at Princeton, Ind., on November

P. C. Branch

15, 1938; general foreman at Birmingham on March 16, 1942, and master mechanic at Ludlow on January 8, 1945.

Car Department

G. H. Rushford has been appointed car foreman of the Michigan Central, with headquarters at Battle Creek, Mich.

L. F. Rozesky, assistant supervisor, car repair of the Erie at Cleveland, Ohio, has been named chief A. A. R. inspector at Cleveland.

F. J. Larrissey, chief A. A. R. inspector of the Erie at Cleveland, Ohio, has been appointed chief shop inspector with headquarters at Cleveland.

Obituary

E. F. Richardson, superintendent of motive power of the Bessemer & Lake Erie at Greenville, Pa., died there on February 3 after a brief illness. Mr. Richardson, who was 64 years old, was a native of Greenville, and had been employed in the mechanical department of the Bessemer & Lake Erie for 45 years.

James E. McQuillen, who retired in February, 1943, as mechanical superintendent of the Gulf, Colorado & Santa Fe (part of the Atchison, Topeka & Santa Fe System) at Galveston, Tex., died in that city recently. Mr. McQuillen was born at Rochester, N. Y., on January 25, 1873, and attended the Sacred Heart Academy, Palestine, Tex. He entered railway service in October, 1887, with the International-Great Northern as an engine-house caller. He subsequently served as a machinist apprentice on the International-Great Northern and as machinist, foreman and general foreman in various railroad shops in the United States and Mexico until September, 1901, when he went with the G. C. & S. F. as a machinist at Temple, Tex. He later became enginehouse gang foreman; in December, 1902, general foreman at Gainesville, Tex.; in November 1906, master mechanic at Silsbee, Tex., and in August, 1913, mechanical superintendent, with headquarters at Cleburne, Tex. His headquarters were later transferred to Galveston.

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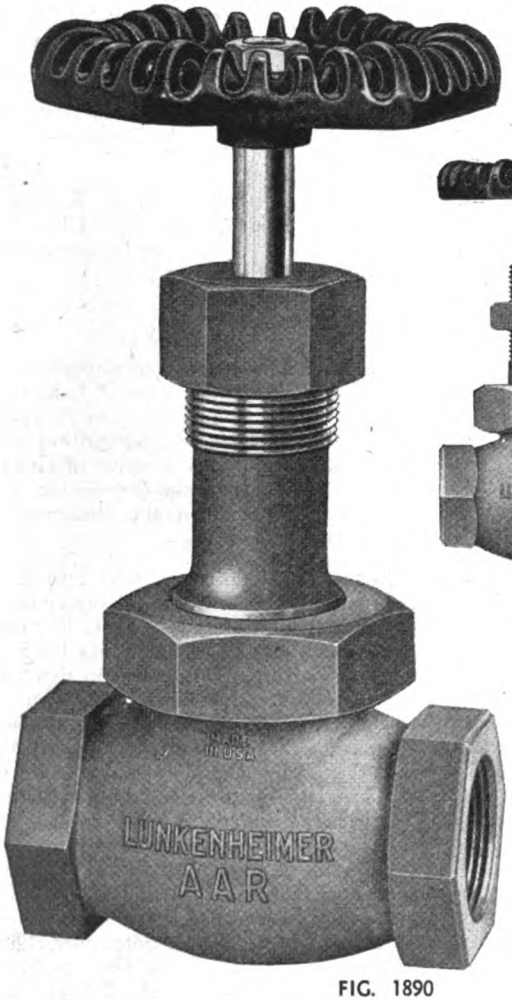

FIG. 1890
Inside Screw

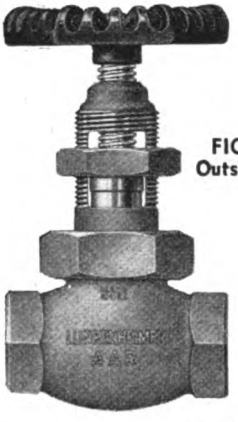

FIG. 1896
Outside Screw

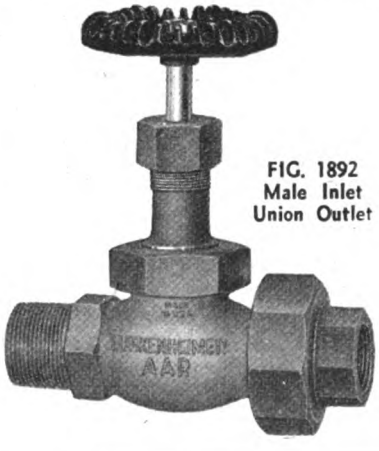

FIG. 1892
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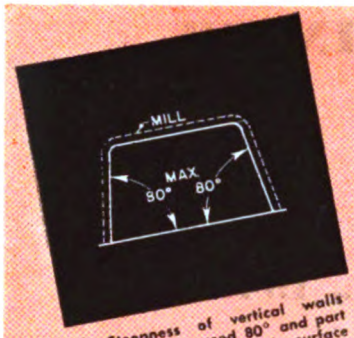
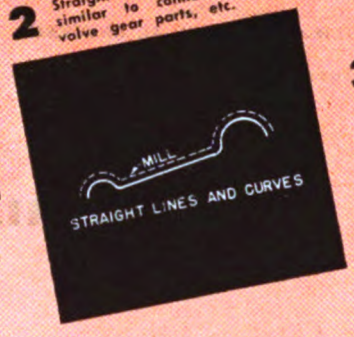
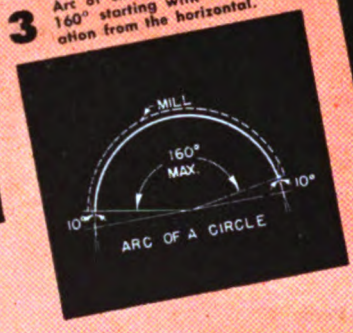


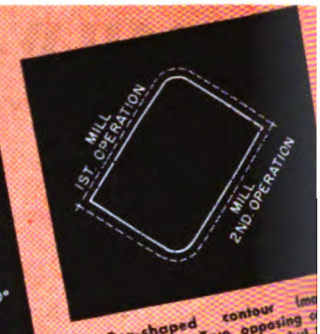
1 Steepness of vertical walls must not exceed 80° and part milled on external surface only.

2 Straight lines and curves, similar to connecting rods, valve gear parts, etc.



3 Arc of circle must not exceed 160° starting with 10° inclination from the horizontal.





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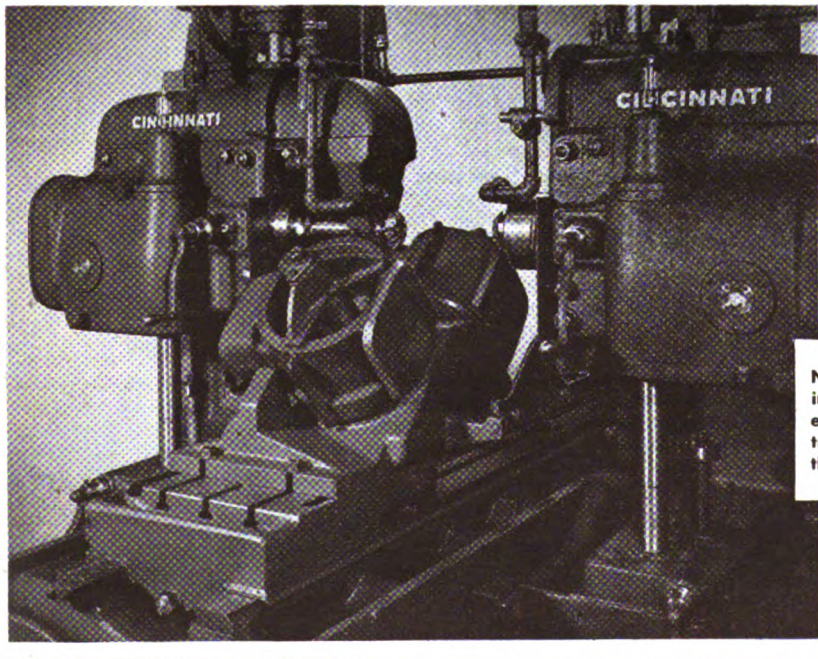
Profiles or straight lines blending into curves always present a tough machining problem on conventional equipment. On a CINCINNATI Tracer Controlled Hydromatic, accurate profiles are milled automatically, duplicating the outline of a template. And the table feed is automatically varied, assuring maximum efficiency of metal removal ... eliminating any possibility of cutter breakage.

The four drawings shown here indicate the range of profile shapes which may be milled on these efficient machines. How many profile milling jobs in your shop fall within these classifications? You probably will find many of them, such as the channeling of connecting rods. Our engineers will be glad to recommend the proper equipment and method.



Illustrated above is the CINCINNATI Tracer Controlled Hydromatic Milling Machine (Duplex model). Both the Plain and Duplex models are available in 12 sizes, with table travels up to 90". Catalog M-1295 gives complete information and specifications. Sweet's Catalog File for Mechanical Industries contains a brief description of these machines.

No. 45-48 Duplex Tracer Controlled Hydromatic, milling the bevels on cylinder head retainers for Diesel engines. The operation is handled progressively, by transferring the part from one side of the fixture to the other.

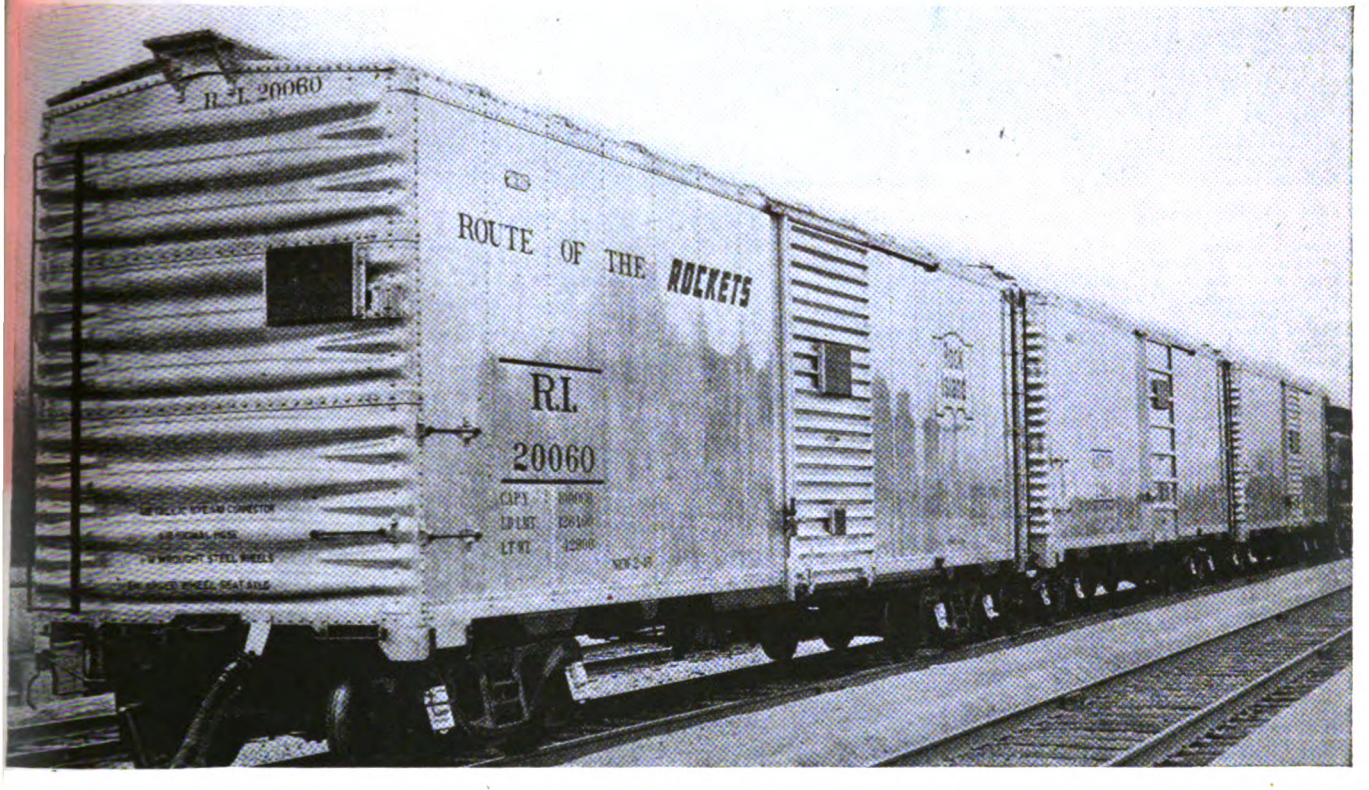
CINCINNATI

THE CINCINNATI MILLING MACHINE CO. CINCINNATI, 9 OHIO, U.S.A.

TOOL ROOM AND MANUFACTURING MILLING MACHINES ... SURFACE BROACHING MACHINES ... CUTTER SHARPENING MACHINES

Three Roads Buy

Aluminum Alloy Box Cars



First of 30 cars designed by Reynolds engineers and built by Mt. Vernon are delivered to the Alton, C.R.I.&P. and M.&St.L.

THE first three box cars, designed especially for the use of strong, aluminum alloys for side frames, as well as exterior sheathing, ends, roof, doors and all other parts of the superstructure, were turned out by the Mt. Vernon Car Manufacturing Company, Mt. Vernon, Ill., during the latter part of February. These cars, built primarily of Reynolds aluminum alloy R-301 and designed by engineers of the Reynolds Metals Company, Chicago, comprise part of an order for 30 cars, or 10 cars each for the Alton, the Rock Island and the M. & St. L., delivered and placed in service on these three roads during March.

This car design has been developed in conjunction with the Car Construction Committee of the A.A.R. Mechanical Division and permission granted to build 50 cars for use in general interchange service. As a matter of fact, the Rock Island cars with steam and air signal lines, special brake equipment, swing-motion trucks and roller bearings on five cars, are being used for head-end service in high-speed passenger trains. The Alton cars, also having special equipment, and friction-bolster trucks, are designed for head-end service in local passenger service. The M. & St. L. cars are intended for freight service only and for the present, at least, are more or less confined to service on the owning road so that their performance may be better studied.

The story of the new Reynolds 50-ton aluminum box car is told in the four accompanying tables. The primary objective in developing this particular type of car was not to achieve maximum weight reduction but to produce a lightweight design of exceptional strength and durability, high corrosion resistance, low center of grav-

Partial List of Materials and Equipment on 30 Reynolds Aluminum Box Cars Built for Three Railroads by the Mt. Vernon Car Manufacturing Company

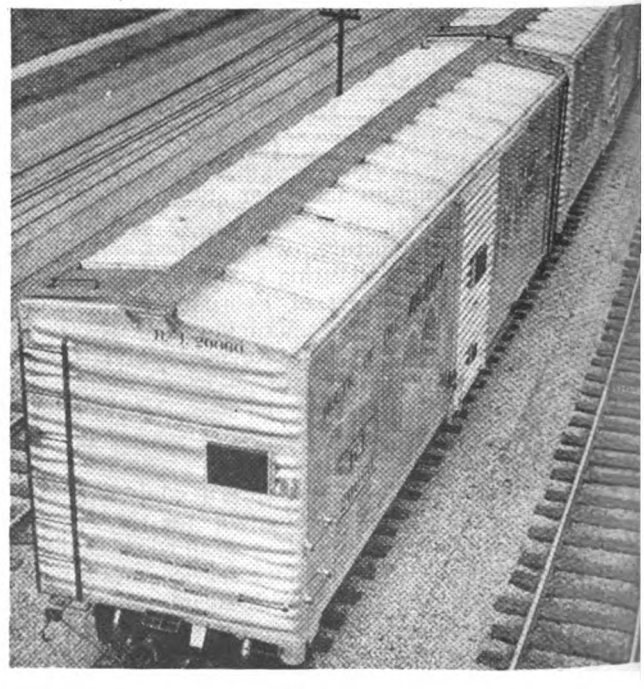
	Alton (10 cars)	Rock Island (10 cars)	M. & St. L. (10 cars)
Air brakes	Westinghouse AB1B	Westinghouse AB1B	New York AB
Air brake pipe	Byers extra heavy w.i.	Steel	Extra heavy steel
Axles	Pittsburgh, hollow	Carnegie-Illinois	Pittsburgh, hollow
Body brake levers	Schaefer	Car builder	Car builder
Bolsters and side frames	Cardwell (2 cars) Buckeye (8 cars)	Buckeye	Buckeye Pittsburgh Steel*
Bottom rods	Schaefer	Schaefer	Schaefer
Brake beams	Creco No. 15	Creco No. 15	Creco No. 15
Brake beam hangers	Schaefer	Schaefer	Schaefer
Brake beam supports	Creco 3-point	Creco 4-point	Grip Nut
Brake hd. wear plates	Illinois Ry. Equip.	Schaefer	Illinois Ry. Equip.
Brake pipe clamps	Illinois Ry. Equip.	Car builder	T-Z Ry. Equip.
Brake shoes and keys	Am. Brake Shoe	Am. Brake Shoe	Am. Brake Shoe
Brake steps	Apex	Apex	Apex
Branch pipe anchor	Illinois Ry. Equip.	Car builder	T-Z Ry. Equip.
Cotters	Gustin-Bacon	Common	Central Ry. Equip.
Couplers	National Malleable	Buckeye	National Malleable
Coupler cush. device	Standard Ry. Equip	Standard Ry. Equip	Standard Ry. Equip
Coupler yokes	Buckeye	Buckeye	Buckeye
Defect card holders	Apex R 4 A	Apex R 4 A	Apex R 4 A
Doors	Superior (5 cars) Camel (5 cars)	Camel	Camel
Draft gear	Cardwell West.	Miner (5 cars) Card. West. (5 cars)	Miner A-22-XB
Draft key ret. lock	Illinois Ry. Equip.	None	Illinois Ry. Equip.
Dust guards	Ajax	Plywood (5 cars)	Laminated wood
Ends and roofs	Standard Ry. Equip.	Standard Ry. Equip.	Standard Ry. Equip.
Floor bolts and nuts	MacLean-Fogg	Grip Nut	MacLean-Fogg
Floor clips	MacLean-Fogg	MacLean-Fogg	MacLean-Fogg
Hand brake	Ajax	Equipco	Superior
Journal bearings	Magnus, Satco	Magnus, Satco (5 cars) Timken (5 cars)	Magnus, Satco
Journal boxes	Cast in side frames	Fort Pitt (5 cars) Timken (5 cars)	Cast in side frames
Jour. box lids (alum.)	Motor Wheel	Alco (5 cars) Timken (5 cars)	T-Z
Journal packing	Spring Pkg. Co.	Spring Pkg. Co. (5 cars)	Spring Pkg. Co.
Plackard bd. brackets	Trans. Specialties	Trans. Specialties	Trans. Specialties
Roof insulation	Dednox	Insulmat	Plywood
Running boards	Apex	Apex	Apex
Side bearings	Stucki	Stucki	Stucki
Signal pipe	Byers standard w.i.	Extra heavy steel	Crane steel
Slack adjusters	Royal K-2	.....	.....
Snubbers	Card. West. (8 cars)	.....	.....
Springs	Card. West. (6 cars) Am. Loco. Co. (4 cars)	Standard Car Truck	Am. Loco. Co.
Spring plates	Card. West. (2 cars) Am. Loco. Co. (8 cars)	None required	T-Z
Steam line	Byers ex. heavy w.i.	Extra heavy steel	None
Truck brake levers	Schaefer	Schaefer	Schaefer
Trucks	Cardwell (2 cars) Double truss (8 cars)	Barber S-4-L	Barber S-2
Truck stabilizer	Card. West. (2 cars)	Barber S-4-L	Barber S-2
Waste retainers	Spring Pkg. Co.	Spring Pkg. Co. (5 cars)	Spring Pkg. Co.
Wheels one-wear steel	Carnegie-Illinois	Carnegie-Illinois	Carnegie-Illinois
Pipe insulation	Union Asbestos	Union Asbestos	None
Steam end valves	Vapor	.....	.....

* Side frames on 10 cars.

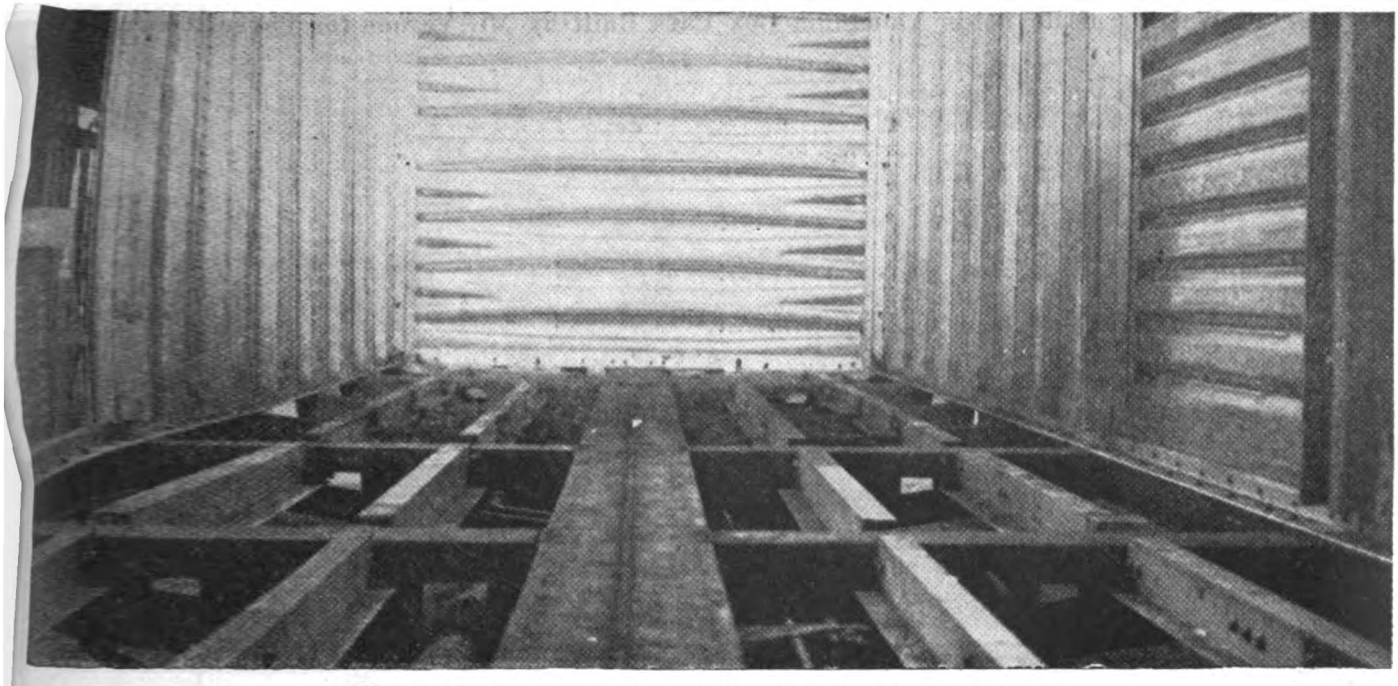
ity, increased potential load capacity and one which could not only be built new but repaired and maintained with tools and equipment already available in car builders' and railway shops. Service experience with the 30 cars now under construction is expected to prove the availability and adaptability of aluminum as a structural material for box cars in a design especially developed to meet the exacting requirements of railway service.

Construction of the Aluminum Car

In order to meet A.A.R. strength requirements and the present preference of a great majority of railway mechanical officers, the underframe of the Reynolds car comprises welded steel construction with a carbon steel center sill, alloy steel bolsters and cross bearers, steel center plates, draft lugs, etc. The longitudinal floor supports, however, are made of aluminum, also the side sills, side plates and all other parts of the car superstructure, except the door track and fixtures and the safety appliances which are of steel. A little less than one-half of the car-body weight is steel and about one-third aluminum, the balance being lumber, car cement, paint, etc. Due to the all-aluminum superstructure, the center of gravity is unusually low, in the Rock Island car, for instance, only 48 in. above the rail when empty. The center of gravity is somewhat higher for those with lighter trucks.



The aluminum car from the top



The floor stringers in the underframe, the side posts and ends are aluminum

An example of the way in which car strength has been secured at some sacrifice in weight saving is afforded by the side and end construction. Twenty-four side posts are provided in the design, as compared with 16 in conventional steel cars. All posts are large extruded sections which keep outward deflection of the car sides under full load within desired minimum limits, thus assuring, among other things, easy-operating side doors. The side posts, in conjunction with 1/8-in. side sheets, are firmly riveted in place and constitute, in effect, deep girders which keep the deflection of the car at the center under heavy loads within conventional limits. Stresses are carried across the door openings by continuous side plates of large cross section at the top and bulb angle re-inforcement to the side sills at the bottom.

The car ends, of three-piece riveted construction, with extruded aluminum W-corner posts, are designed with ample strength to hold lading against any ordinary road service or switching shocks, the bottom, intermediate and top sheet thicknesses being 5/16 in., 1/4 in., and 3/16 in., respectively.

Aluminum rivets used in the car construction are driven cold up to 5/8 in. in diameter with pressure riveting machines wherever possible. Where pneumatic hand hammers have to be used the rivets are driven hot. All floor bolts and clips, lining-strip bolts, stud-rivet bolts and nuts are aluminum. One interesting advantage of the use of aluminum floor bolts to hold the tongue-and-groove flooring is that the car may be loaded with explosives without covering the bolt heads, as ordinarily required by I.C.C. Bureau of Safety regulations.

The journal-box lids, made of aluminum, also constitute a safety feature, as they reflect light from automobile headlights at night and indicate the presence of cars on highway crossings. Spring packing, with aluminum springs, is kept in place by Holdrite packing retainers, made of aluminum spring material, R-303-T 315. The new type of coupler-centering device which is installed gives spring support to the coupler in both vertical and lateral movement, an especially desirable feature for the cars when used in passenger train service.

Material Used in Reynolds Aluminum Box Car Bodies

Aluminum Parts

Side sheets	Draft gear carriers
End sheets	Floor bolts
Roof sheets	Floor clips
Roof carlines	Nailing piece bolts
Door sheets	Rivets in superstructure
Door trimmings	Hand brake housing
Running board	Journal box lids
Brake step	Defect card holders
Intermediate post	Routing board brackets
Door posts	Placard board brackets
Corner posts	Spring packing springs
Side sills	Journal-box packing retainers
Side plates	Brake badge plate
Floor supports	Builder's badge plate
Diagonal braces	Marker lamp brackets
Follower plates	

Steel Parts

Center sills (carbon)
Bolster and crossbearers (alloy)
Bolster center fillers
Striking castings and draft lugs
Couplers and draft gears
Crossties (alloy)
Center plates
Bulb angles at doorways
Door track and fixtures
Air brake equipment
Safety appliances

31 aluminum parts weigh 7,017 lb.,* or 28.8 per cent of car body weight.
11 steel parts weigh 10,823 lb.,* or 44.5 per cent of car body weight.
Other materials, including lumber, insulation, car cement, paint, etc., weigh 6,500 lb.,* or 26.7 per cent of car body weight.

* Rock Island car—Weight would be slightly different for the other cars.

General Dimensions of Reynolds Aluminum 50-Ton Box Car

Length over pulling face couplers, ft.-in.	44- 4
Length inside, ft.-in.	40- 6
Length truck centers, ft.-in.	30-10
Width overall (door fixtures), ft.-in.	10- 7 1/4
Width over frame, ft.-in.	9- 9 5/8
Width inside, ft.-in.	9- 2
Height from rail to top running board, ft.-in.	14-11 3/4
Height from rail to floor, ft.-in.	3- 7 3/4
Height inside, ft.-in.	10- 6
Clear height door opening, ft.-in.	9-10 11/16
Clear width door opening, ft.-in.	6- 0
Cubic capacity, cu. ft.	3,900
Load capacity, lb.	100,000

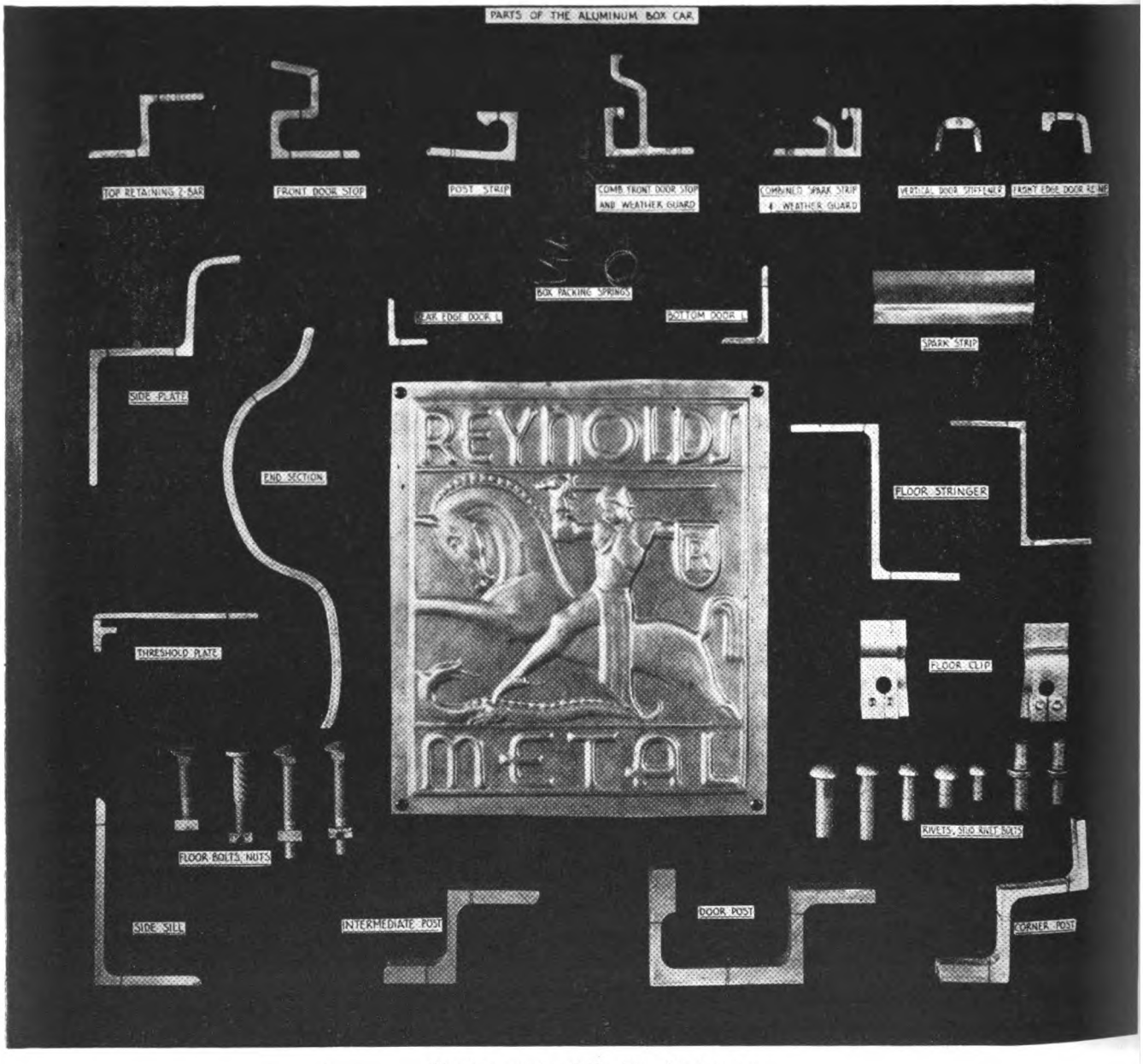
Painting

Steel underframes of the car are painted with regular primer paint and one coat of car cement is applied. Aluminum parts of the underframe are painted with a

Detail Weights of Reynolds Aluminum Box Cars Built by Mt. Vernon for Three Railroads

	Alton* (lb.)	Rock Island† (lb.)	M. & St. L.‡ (lb.)
Underframe, primarily welded steel except floor supports	10,600	10,600	10,200
Side sheets, side sills and all posts, made of aluminum	3,995	3,998	3,996
Ends, 3-piece aluminum	1,028	1,028	1,028
Roof, complete aluminum	833	833	833
Doors, aluminum except for steel track and fixtures	652	738	738
Running boards and brake steps, made of aluminum	186	186	186
Safety appliances, steel	377	377	377
Hand brakes, aluminum	69	80	72
Lumber, insulation, car cement and paint (1)	6,500	6,500	6,570
Weight of all aluminum parts (2)	6,969	7,017	7,015
Weight of all steel parts (3)	10,771	10,823	10,415
Total car body weight, (1)+(2)+(3)	24,240	24,340	24,000
Weight of trucks	13,760	18,560	13,000
Light weight of car	38,000	42,900	37,000

* These cars have AB1B brakes, steam and signal lines, Cardwell stabilized double-truss spring-plank trucks, hollow axles and one-wear steel wheels.
† These cars have AB1B brakes, steam and signal lines, Barber stabilized swing-motion trucks, solid axles, one-wear steel wheels and roller bearings (5 cars).
‡ These cars have AB brakes, hollow axles, Barber stabilized spring-plankless trucks S-2 and one-wear steel wheels.



Aluminum parts of the Reynolds box car

zinc chromate primer and one coat of car cement is applied. The inside surfaces of the superstructure from the side sill to 15 in. in height are painted with a zinc chromate primer. All aluminum surfaces in contact are painted with zinc chromate primer, as a sealer. The contact surfaces between aluminum and steel are painted with zinc chromate primer on the aluminum and an ordinary primer coat on the steel surface. Roof joints are sealed with Alumilastic and all other joints caulked with the same material. No paint is used on the car exterior except stenciling which is applied after a light etching of the surface beneath the letters and numbers.

A Symposium on

Responsibilities of Foremen

THE following papers were prepared for the year book of the Master Boiler Makers' Association by members of its Advisory Board. A note of commendation on the safety record being achieved in the boiler departments from H. H. Urbach, mechanical assistant to vice-president, Burlington, has been omitted. The others are abstracted.—EDITOR.

A Wide Range of Interests

By E. R. BATTLEY

Chief of motive power and car equipment, Canadian Pacific

It is generally known and freely admitted that the railways have during the war years undertaken and performed a remarkable job. One of the contributing factors is their ability to keep locomotives on hand in constant service. To the rendering of such service the boiler inspector and his staff contribute a great deal.

The Interstate Commerce Commission in the United States, and the Board of Transport Commissioners in Canada, recognized the importance of the status attaching to a boiler inspector when they formulated Section 6 (similar law in Canada) of the Locomotive Inspection Law.

In framing this law our governments have set an exceedingly high standard for the men whose duty and responsibility it is to protect the railroads from failures due to the improper design, maintenance or handling of boilers. To carry out the requirements set down by law necessitates the services of a specialist, one who has specialized knowledge of boilers, appurtenances and pressure vessels, and who can apply himself and solve the many and intricate problems attached to the proper, economical and safe operation of every type of boiler. This is briefly indicated by the following resume of duties and responsibilities.

The duties of a boiler inspector are to acquire an understanding of the general principles of boiler design, construction, stresses, appliances and materials; to educate himself sufficiently to have a working knowledge of mathematics, drawings and blueprints; to be familiar with and follow the latest methods of making repairs; to study the principles of autogenous welding, composition and amalgamation of metals; to become conversant with the various boiler water treatments and the methods of treating boiler feedwater; to become thoroughly versed in all requirements of inspection laws and company regulations affecting locomotive and stationary boilers, fire appliances and pressure vessels; and to acquire an attitude which enables him to meet and handle all classes of men.

The responsibilities of a boiler inspector are to see that the requirements of all inspection laws and maintenance regulations of the railway in connection with this branch of the service are carried out; to know that all defects disclosed by examination are properly repaired; to know that all inspection forms are made out correctly, showing conditions as they exist; to discourage inferior workmanship and endeavor to create a desire on the part of all employees to take pride in their work; to educate local boiler foremen to compile boiler reports carefully for engines about to be shopped; to know that boilers are being washed out properly; that no accumulation of scale or mud is allowed to form in any part of boilers and to see that proper tools and water pressures are used in the operation; to report to superiors any condition that appears of an unusual character and might lead to future trouble; to be constantly on the lookout for young men of promise who are capable of and willing to take on additional responsibility, and to recommend such men to higher officers so that they might be considered for promotion; and to maintain high standards in keeping with the teachings of the Boiler Makers' Association.

Selecting and Training Supervisors

By F. K. MITCHELL

Assistant general superintendent motive power and rolling stock, New York Central

In building for a future which will be insured of good, capable and efficient boiler supervision, no more important problem than the selection of the supervisor will present itself.

The care with which this task is done will be the measure of future success; the difference between good and unsatisfactory production, between a smoothly functioning organization and unwilling compliance with orders, between harmony and continual labor troubles, between good workmanship and poor workmanship, and finally, between economic and costly operation.

In shopping for the boiler supervisor, as in the case of any shopping for any article you might need, the proper fundamentals behind the task are: first, to know what you want, and second, to start early enough so that when the supervisor is needed you will already have located him. This task requires you to know what kind of man you want; how many supervisors you are likely to need and when you are likely to need them; where you are most likely to find them; how to train them for their jobs, and how to interest them in accepting the job. Taking these requirements in their order let us see how the job should be done.

The supervisor should have a good personality, that is to say, he should have that unexplainable something which makes men like and respect him and makes him like and respect the rights of other men. Next, he should have the natural mechanical ability so that he may readily progress with his job. Then he should have a reasonably good education so that he can understand instructions, clearly convey his instructions to his men, and keep properly all necessary records. Finally, he should have a background of good varied mechanical experience, including design, layout, construction and repair of locomotive boilers and other equipment which is the boiler department's responsibility.

There is another phase of the shopping problem that is often overlooked. Too many candidates for supervisory jobs may result in some of them becoming spoiled and to have too few is just as bad for the organization. The

first and most necessary requisite here is to know your organization. Not only does this mean to know the supervisors, but as far as is humanly possible, every man in the organization from the latest employed laborer to the top ranking supervisor. Only by so doing can you know how many supervisors you should have and how many vacancies for supervisors you are likely to have to fill in any given period. You must know what supervision is necessary to get the best results from your organization, and you must know the capabilities, shortcomings, physical condition, age, attitude and even the home life of your existing supervisors. You must know the mortality rate, retirement dates, the possible loss to other departments and other industries from your supervisory ranks. Such intimate knowledge will serve to answer both the question of how many supervisors you are going to need and about when you will need them.

You are not going to find full-fledged supervisors. What you must look for and find are the candidates for those positions who possess certain fundamental qualifications, some of which are inherent and others of which are susceptible to development. A few such candidates will be found among your existing employees. The balance will have to be inducted into the ranks of your employees through the apprentice systems.

The best candidate is one who has been trained so that his background of experience will eventually fit him for any supervisor's position in the boiler department. Mechanically that means he must be a boilermaker in the true sense of the word. The scope rule in the majority of labor agreements spells out the things which he must be qualified to do and do well. Part of this you must see that he learns during his apprenticship. The balance, which is even greater, you must give him after he becomes a journeyman. Whenever possible this experience should include not only shop but also engine terminal work.

While he is receiving this mechanical training you must follow him closely and study him intently in order to be sure that he has those other essential supervisory qualities which you suspected he had when he started his apprenticeship. If you find that you were wrong and that he does not possess them in the necessary degree, the fairest thing to him and to your company is to cross him from your potential supervisors' list at once and make the best mechanic out of him that you can. If your close observance of him verifies the fact that he possesses those qualifications to a satisfactory degree, start at once to develop him into a supervisor. Diamonds are not mined without sweat, and after being mined are not in shape for the market without painstaking care, cutting and polishing. No more can you expect to produce a good supervisor without similar care, shaping and polishing. Infinite care in polishing and improving his better qualities, and in eliminating or minimizing his objectionable ones will, in the end, pay dividends in the satisfaction of producing a supervisor who will fulfill completely the assignments he will later undertake. To that end, no amount of counsel, admonition, advice and example in laying out and assignment of work, planning of work to fit production schedules, diplomatic handling of men, learning and administering labor agreements and methods of insuring confidence in others, can be amiss.

In recent years there has been a growing tendency on the part of men to reject positions as supervisors when they are offered. Have you given any study to the reason for this? Here are a few which may throw some light on the answer to the problem we are considering:

1—Are we offering these positions to men who have not been trained for them and who realize that fact?

2—Are we exhibiting a tendency to place qualified men on supervisory jobs and then not giving them our advice and counsel on how to handle them?

3—Have they noticed that others thus placed have not been given a break and if they have appeared to be faltering merely demoted or discharged without due consideration?

4—Have we shown by past example that our supervisors have been subjected to abuse when things are not going right?

5—Have we failed to make them a part of management and as such not taken them into our confidence?

6—Have we failed to maintain a proper spread between their wages and the earnings of the men they are required to supervise?

7—Have we failed to accord them the rights and privileges which their positions should merit?

8—Have we, by our actions, given them the feeling that in leaving the protection of a labor agreement and joining the ranks of the supervisor where no such protection exists they are jeopardizing themselves?

9—Have we in the past led too many to believe they were being considered for supervisory positions and then, without any attempt to explain the situation to them, advanced others around them, thus souring many on supervisors' jobs?

10—Is our system of advancement wrong in that we have too often shown that we allow personalities and friendship to influence the selection of men for such advancement?

If we have been guilty of one or all of these then it is no wonder that we are finding that the supervisor's position is no longer attractive. Let me suggest that you members of the Master Boiler Makers' Association start at once to analyze this situation on your own railroads and to do your part to stop any such practices which you find to exist.

These steps need to be taken if the selection and training of boiler department supervisors is to be successfully handled. First, clean house of any existing practices or conditions which tend to make the supervisor's job unattractive. You cannot train a man for nor get him to desire a position which is not attractive to him. Second, learn intimately your present supervision and solicit their assistance in selecting and training men to succeed them. Third, study your problem until you know as nearly as is possible what your supervisory needs are. Fourth, begin now, with the assistance of your present supervisors, to look for supervisory material within your own ranks. Fifth, as soon as possible, begin inducting likely supervisory material into your apprenticeship ranks. Finally, set up a training program which will progressively prepare candidates for supervisory positions to assume those duties when needed.

Association Work

By E. L. GRIMM

General mechanical superintendent, Northern Pacific

Mechanical associations are designed and organized to bring about improvement, both for the individuals participating and for the railroads supporting such associations. They widen acquaintanceships, promote self-confidence, and develop initiative and leadership in individuals. These qualities manifested in supervisors directly benefit the railroads through improved output.

Mechanical associations program and stimulate group study and research and the resulting exchange of ideas and experiences at conventions are later published in the

annual proceedings and technical press for the benefit of all. One of the most important benefits is the development and adoption of standards, and the recommendation of improved practices.

Unquestionably, mechanical associations have played a distinct and valuable part in the development, organization and structure of railroads in the past, and have earned a permanent place in future railroad economy. Were this not true, they would long since have ceased to exist. While the demands of war have limited the activities of mechanical associations, their importance and services will be increased because of the problems that will arise during the post war reconstruction and the periods of keen transportation competition beyond.

Training Boilermaker Apprentices

By B. M. Brown

General superintendent motive power, Southern Pacific

The work of the craft, of which your organization is representative, is most essential to the successful operation of the railroads. In it, a comprehensive and efficient system of apprentice training is necessary to supply the lack of skilled labor now facing the railroads. It is only through apprenticeship and proper apprentice training with assured continuity that we will be able continually to set up new and higher standards of craftsmanship. This must be done by the new blood injected into the organization. If we want future well-trained supervisors, we must begin by properly training our apprentices today. In order to become a real leader, a man must first learn to be a good follower, and the more he knows about his business the better.

Apprenticeship training was greatly retarded on our American railroads during the depression and as a result we have a shortage of master craftsman today. Due to the fact that the full benefits of such a training program are not attained for many years, the subject calls for intelligent, long-time planning.

The interviewing, qualifying, and selecting of applicants is an important function. When a young man, who is sincerely interested in his future, applies for an apprenticeship, he must be given conscientious guidance for his full time of apprenticeship. Apprentices must be advanced from one series of operations to another under the direction of skilled workers and instructors in accordance with a planned sequence of work processes until they have mastered their chosen craft. It is advisable to have a supervisor of apprentices in every large shop.

Shop schedules for apprentices should be worked out for each craft in line with the facilities at each shop or point where apprentices are employed. Through experience, the length of time normally required for mastering each job operation has been set. The employer and the journeyman know in general what this schedule of job operations should be. The apprentice and his parents know only the end result desired. He must be instructed in mathematics, trade science, blue-print reading, mechanical drawing and other subjects pertinent to his craft. Employers should see that the apprentice gets a rounded work experience on the job and the necessary hours.

It requires time for the apprentice to reach his maximum capacity for all-around skill because he is less experienced than the journeyman. Because as a younger man he may be less careful, the apprentice should be given special instruction in safety on the job. We must give apprentices a thorough and intensive technical training for there are many things which they cannot learn by practical experience. Competent instructors are necessary. The school where training is done should keep in close touch with the industry.

Many an apprentice has been discouraged from mastering the art of his craft through lack of interest on the part of the immediate shop management. Under such conditions, the apprentice has to fight all kinds of trouble single-handed. Some of them come out all right by force of ability and determination. It is the responsibility of management to show an interest in these boys. Most of them are ambitious and are willing to conform to any reasonable standards if we will take the initiative in encouraging them and make it possible for them to conform to the standard set. It is logical to expect that boys will put forth their best efforts when they know every effort is made to arrange all the conditions favorable to their training. There is something very human in the response to the feeling of "getting a good break."

Apprentice training of the future must be something more than has been attempted on any wide scale in the past. The duty and responsibility of training skilled labor must be assumed by the management of railroads and public-spirited companies, and also by organizations representing the employees. Apprenticeship must be made more attractive in order to draw a good type of youth who can best profit from the training.

It is possible for apprentices to attend evening classes and to profit from them either in broader culture or greater skill in their occupations. Better co-operation with trade schools and vocational courses in public schools will help our apprentice system. Some vocational work attempted in schools has failed to win industry's respect but there are cases in which excellent work has been done in the way of preliminary instruction and development of aptitudes for learning. Industry's co-operation will help to improve and expand this work and make it of greater practical value to both employer and employee. Public school cooperation in the teaching of theory can also be made a valuable adjunct.

The present trend in shop practice encourages the development of specialists rather than all-around skilled mechanics. This has been one of the factors working against the restoration of apprentice training to its former high standard. This fact, in addition to others, such as the expense involved in training men who may ultimately resign after being trained are problems we must be prepared to meet. Adoption of uniform standards in the matter of hours of shop work and study, time to be spent in the various stages of training, rates of pay, and attainments to be required for a certificate of graduation, together with adequate supervision over the training program, can help materially to assure the usefulness to industry of the product of these courses. The needs of industry, not next year, but five years and ten years hence, must be planned for now. Measures for meeting this situation cannot be adopted and put into use too soon.

What about the mechanics of tomorrow? The number of apprentices was greatly reduced during the depression years and, in an effort to hold down expenses, training systems were largely thrown into the discard or greatly curtailed. This has resulted in a serious lack of skilled men to meet the greatly expanded demands of the present emergency. These facts are generally recognized and have been a matter of great concern to railroad mechanical department supervisors. The difficulty is accentuated by the fact that marked progress has been made in locomotive and car design to meet the exacting present day and post-war conditions and higher standards of workmanship must be insisted upon in the future. Apprentice

(*Continued on page 152*)

Why The

Geared-Turbine Locomotive?

By Charles Kerr, Jr.*

The characteristics of the steam turbine adapt it as a prime mover of high-speed, high-capacity motive-power

HE first geared-turbine steam locomotive in America represents outstanding advancement in American railroading. Although new developments usually are first designed and built on a relatively small scale, the new geared turbine locomotive, with a rating of 6,900 shaft horsepower, is one of the most powerful high speed locomotives in the world. Thus, not only did the participating parties undertake the construction of a radically new locomotive, but also one of exceedingly high horsepower capacity.

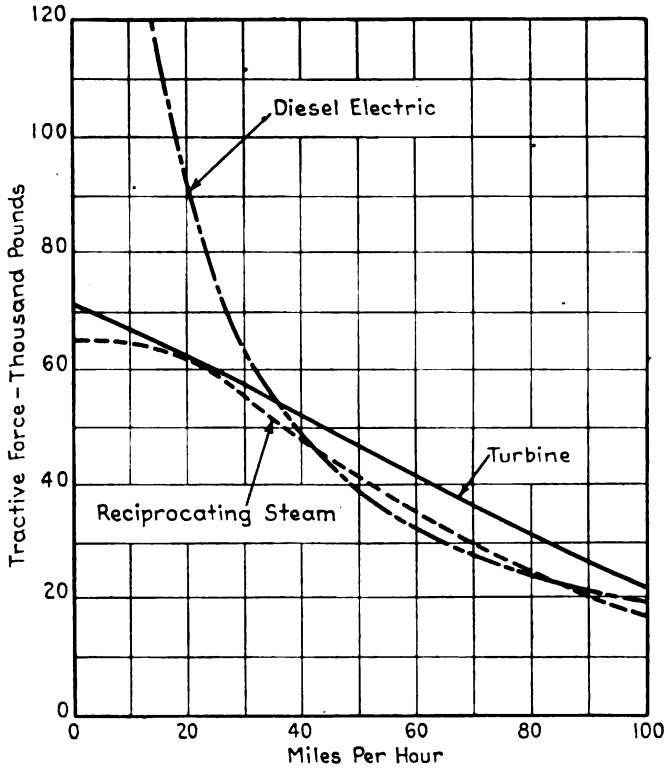


Fig. 1—Tractive force at the rail for the steam-turbine, a reciprocating steam, and a Diesel-electric locomotive

The propulsion equipment of the Pennsylvania Class S-2 locomotive was designed specifically to operate with a conventional fire tube boiler, and at pressures and temperatures commonly used with such boilers. Furthermore, it was designed for a locomotive which would be used primarily in high-speed passenger and freight service. Fig. I shows the speed-tractive force curve compared with that for a conventional two-cylinder reciprocating steam locomotive, with the same weight on drivers and with a boiler designed for equal evaporation. At standstill and at the slower speeds, the performance of the two is essentially the same, but at the higher speeds, the tractive force of the geared turbine unit becomes considerably greater. Thus for the same amount of steam consumed it can handle a larger train at the same speed, or an equivalent train at a higher speed.

In Fig. 2, the horsepower developed at the rail is shown both for the turbine drive and for a conventional reciprocating locomotive where each have the same capacity boiler. The turbine locomotive produces at the rail a maximum of 6,550 hp. against 5,630 hp. for the reciprocating locomotive. At 100 m. p. h. the turbine horsepower

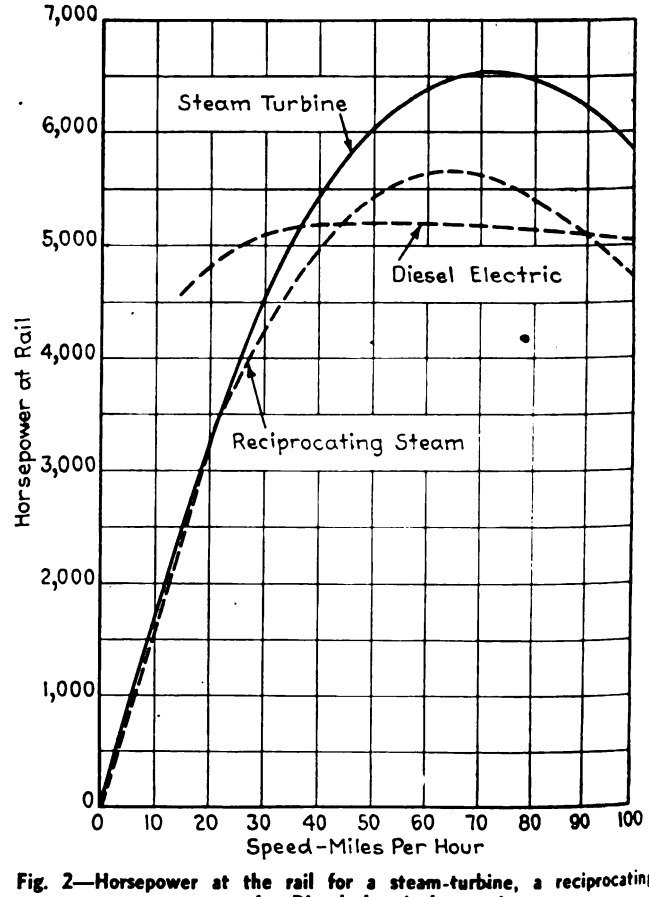


Fig. 2—Horsepower at the rail for a steam-turbine, a reciprocating steam, and a Diesel-electric locomotive

Table I—The Class S-2 Turbine Locomotive and 6,000-hp. Diesel-Electric Locomotive

	Class S-2	Diesel electric
Total weight, lb.	1,029,400	1,039,000
Weight on drivers, lb.	260,000	693,000
Overall length, ft.-in.	122-7¼	223-0
Starting tractive force, lb.	70,500	173,000
Prime mover horsepower for traction	6,900	6,000
Maximum rail horsepower	6,550	5,200
Locomotive weight, lb. per hp.	152	200

* Consulting Transportation Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

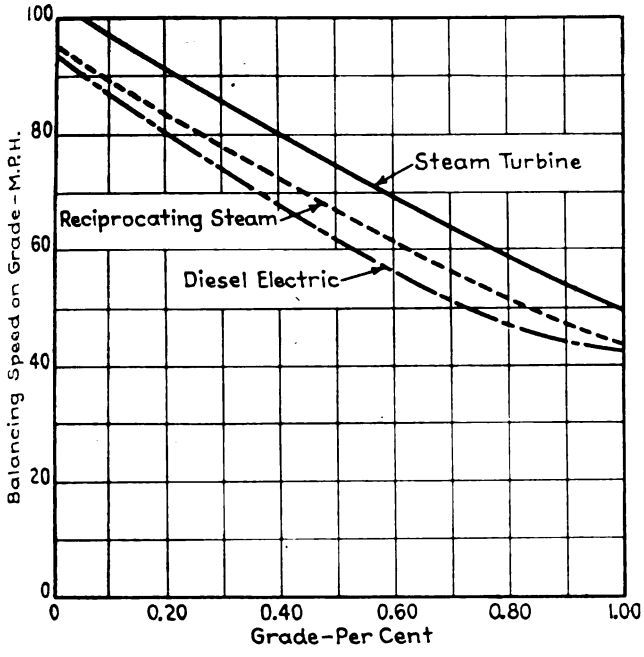


Fig. 3—Balancing speed on grades for steam-turbine reciprocating steam, and Diesel-electric locomotives

is 5,820 against 4,750. As railroad speeds are continually raised, the larger outputs at the higher speeds become of greater importance.

The largest Diesel-electric passenger locomotive built is a three-unit locomotive developing 6,000 Diesel-engine hp. The performance curve of this Diesel-electric is also shown on Figs. 1 and 2 for comparison. The Diesel produces a very high initial starting tractive force due to the electric transmission, but suffers in capacity at the higher speeds. Table I further compares a 6,000-hp. Diesel-electric with the Class S-2 turbine locomotive.

With the tendency towards lightweight rolling stock, many have questioned the wisdom of the large capacity

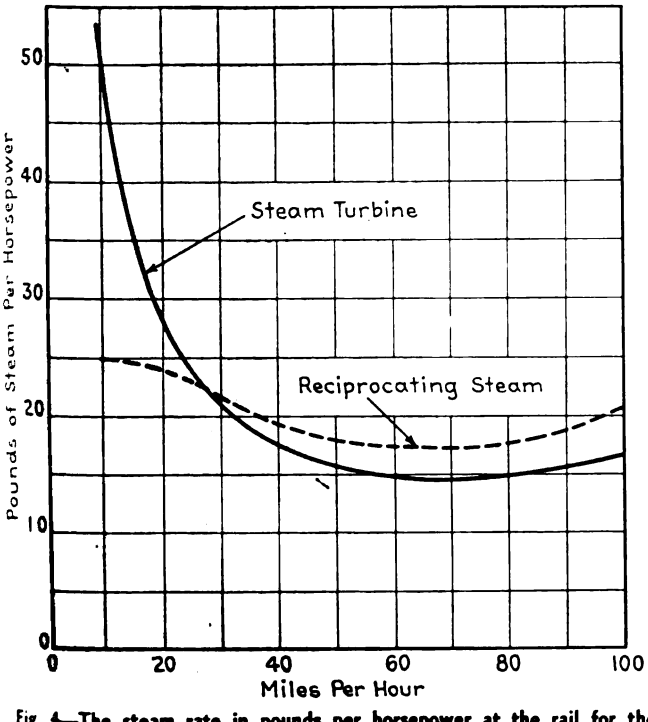


Fig. 4—The steam rate in pounds per horsepower at the rail for the steam-turbine and a reciprocating steam locomotive

Table II—Time in Minutes to Accelerate a 1,200-Ton Train to Various Speeds

Speed, m. p. h.	Type of Locomotive: Class S-2	Reciprocating	Diesel
70	5.12	5.81	5.63
80	6.80	8.18	8.50
90	9.46	13.26	14.26
100	16.00	A	A

A—Maximum speed approximately 95 m. p. h. with 1,200-ton train.

locomotives. An essential of high schedule speeds, both in freight and passenger service, is not only the ability of the locomotive to maintain these high speeds on level track, but also to maintain speeds on adverse grades, and to accelerate rapidly from station stops and slowdowns. Fig. 3 shows the speeds which can be main-

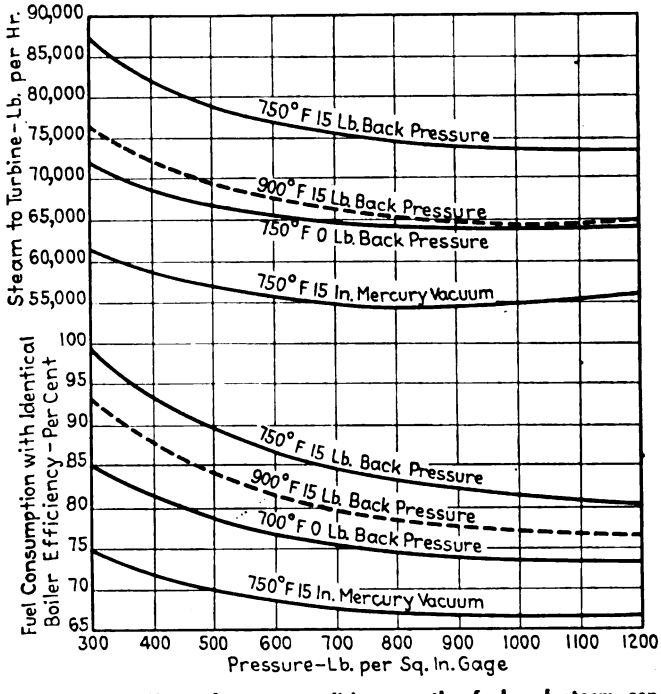


Fig. 5—The effect of steam conditions on the fuel and steam consumption of a 6,000-hp. geared-turbine steam locomotive

tained by the three locomotives on grades ranging from level track to 1.0 per cent when hauling a 16-car 1,200-ton train and when supplying the power for air conditioning the cars.

Table II shows the time in minutes required by these same three locomotives to accelerate this same 16-car train from standstill to various speeds on level track.

Table III—Horsepower Required to Handle Freight Trains at Various Speeds on Level Track

Speed, m. p. h.	3,750 tons, 75 cars	5,000 tons, 100 cars
40	2,370	3,110
50	3,610	4,720
60	5,270	6,910
70	7,370	9,630

This ability to accelerate the train rapidly, when multiplied by numerous stops and slowdowns, results in a very material overall increase in average speed, and hence in improved passenger appeal.

In the postwar period, high-speed freight service will receive equal rank with high-speed passenger service in the railroad's fight to keep the traffic on the rails. The locomotive rail horsepower required on the very best roadbed to handle large freight trains at various speeds is given in Table III.

A brief glance at these requirements readily shows

that the day of the large locomotive is far from being over, and that a development such as the turbine drive, which increases the capacity of the steam locomotive, will be most welcomed by the American railroads.

As experience is gained with the geared-turbine locomotive, it seems highly probable that even larger turbine locomotives will be produced. When all is said and done, the ultimate limit in the capacity of the steam locomotive is the boiler. It is not generally realized, but the turbine drive removed many of the present limitations now imposed upon the boiler designers who, with this type of locomotive, will enjoy a latitude previously denied them. With the geared-turbine drive, locomotives can be built with smaller wheels, the use of which may to some extent afford boilers of larger diameter, and also make available wider combinations of wheel arrangements. Another factor which has restricted boiler size has been visibility and rail clearance. The shorter wheel base resulting from the smaller wheels allows greater grate area under the boiler. The turbine can utilize steam at temperatures prohibitive with reciprocating locomotives. With future development geared-turbine locomotives of 10,000 hp. may eventually be available for the accelerated post-war passenger and freight schedules of the American railroads.

Fig. 4 illustrates the steam consumption of the turbine drive compared with that of the conventional reciprocating locomotive. At the very low speeds, the turbine is at a disadvantage, but over its normal working range the reverse is true. If a turbine drive were designed for freight service, the turbine blading and the gear reduction

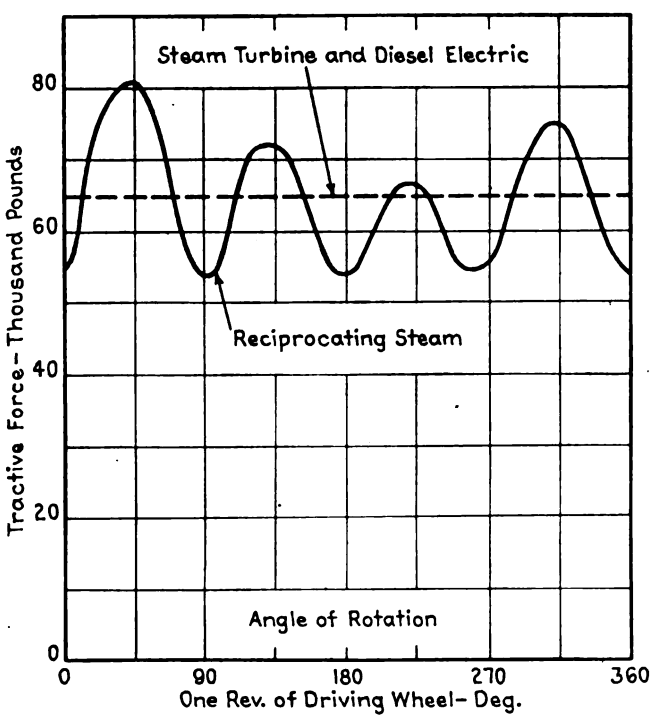


Fig. 6—Torque curves for the steam turbine, reciprocating steam, and Diesel-electric locomotives

would be made more favorable for low-speed efficiency, improving the steam-rate efficiency compared with the performance shown by Fig. 4.

Besides having a better steam rate, the Class S-2 locomotive also utilizes the coal burned in the boiler efficiency. Due to its small wheels and short driving wheel base, it has been possible to equip this locomotive with a large boiler and a large grate. When developing full output, coal is burned at a low rate and the boiler is easily drafted. When burning coal at the lower rates, it is burned more efficiently.

Boiler designers for years have been studying the application of higher pressures and higher temperatures for locomotive use. Many problems are yet to be surmounted before such boilers are available. However, they will likely be perfected, and a successful turbine drive should hasten their development because this type of drive can capitalize fully on the advantages gained from higher pressures, lower back pressures, and higher temperatures. It is extremely difficult to predict how rapidly these boiler developments will take place, but engineering progress is going forward at an unprecedented pace today, and the abundance of coal for fuel purposes in this country is leading to extensive research to find better ways for using it. Out of this development will eventually come a more efficient boiler whereby turbine locomotives will emerge with economies far better than those of the first turbine equipment. The curves of Fig. 5 show how total steam temperature, steam pressures and exhaust pressures affect the efficiency of the turbine drive.

Another feature of the geared turbine locomotive is that it substitutes a uniform torque for a pulsating torque. Fig. 6 shows the torque over a complete wheel revolution for a turbine locomotive and a reciprocating locomotive. Without a reciprocating motion, the rotating elements of the turbine drive can be perfectly balanced, eliminating the undesirable features of unbalanced moving parts.

The turbine locomotive will use either coal or oil as a fuel. In various parts of the country, there are definite economic reasons dictating one or the other as the preferred railroad fuel. Therefore, this is a prime mover which can be used by any railroad wherever located or whatever its source of fuel.

The experience which has been gained in the design and operation of this locomotive indicates that the geared-turbine drive may go far towards revolutionizing the steam locomotive. Its performance characteristics make it a worthy form of motive power for high speed, freight and passenger service where locomotives of large capacity are required.

Responsibilities of Foremen

(*Continued from page 149*)

training methods should be introduced which will protect this situation and furnish an adequate supply of well-trained mechanics for the future. Certainly there is no lack of evidence on the railroads as to the value and importance of the work done by well organized apprentice training systems in the past. The resumption of this activity is necessary and in a way which will meet modern conditions, on a sufficiently large scale to furnish the more highly trained personnel which will be required later.

The best mechanics and supervisors are our own apprentice-trained men. Railroads desiring to maintain a high standard of workmanship in their shops and to have services of men with a deep personal interest in the railroads' maintenance problems must take a more forward looking attitude toward the training of apprentices not only as mechanics but also as future supervisors and administrative officers. More today than ever before, there is a crying need for trained men with exceptional abilities in these capacities. A well-rounded apprentice training program is one of the best means of attracting young men into the ranks and starting them on the road to meet these higher responsibilities.

Wheels for Postwar Service*

By C. T. Ripley†

Wheel maintenance is responsible for one-eighth of total freight-car maintenance charges — Importance of rotundity and freedom from eccentricity calls for accurate wheel-shop equipment

EXPERIENCED railroad men know the importance of wheel and axle work in railroad operation from the safety viewpoint. The wheel and the axle are the most important parts of a car or locomotive, for their failure can cause the most serious type of wrecks due to equipment defects. Because of this fact both the manufacturers and users must continually strive for improvements to cut down the chance of such occurrences even though the present performance record is remarkably good.

Wheel and axle work is also important from the cost viewpoint. Anyone who handles interchange billing realizes how large a percentage of the bills involve wheel charges. In order to arrive at an approximate figure for the cost of wheels and wheel shop work, I have analyzed the expenses of one large railway system and developed the following data: Annual cost of wheels for locomotives (excluding tires), $210,000; passenger-car wheels, $115,000; freight-car wheels, $1,275,000; wheel-shop work, $510,000; total $2,110,000.

In the case of the freight-car wheels, the cost represents about 12 per cent of the total maintenance charges. It is realized that these costs will vary on different railroads, but, if we apply the results of this estimate proportionately to the total car and locomotive ownership of American railroads, we arrive at a total estimated cost for all railroads of about $6,000,000. (Mr. Ripley here described at some length the results of intensive research conducted by the Wrought Steel Wheel Industry and outlined the characteristics of steel wheels adapted to meet modern service requirements for steam locomotives, Diesel locomotives, passenger cars and freight cars.—EDITOR.)

While the steel wheel industry intends continually to develop improvements in all these types of wheels, it appears that it is already well prepared to meet post-war demands. However, it must be recognized that no one type of wheel can be used in every class of service. Judgment must be used in the selection of the types best suited to the service. This has been recognized by the A.A.R. in its specifications for heat treated wheels, which divide such wheels into three classifications: Class *A*, a low-carbon wheel for use with severe braking conditions, but with light loads; Class *B* with medium carbon content for use with severe braking conditions and heavier wheel loads; Class *C* with high carbon content for use with high wheel loads and moderate braking conditions. These three new classes are in addition to the ordinary unheat-treated wheels covered in the old specifications.

The maximum loadings recommended for these classes of wheels when used in locomotives or passenger cars are as follows: Class A, 650 lb. per in. of dia.; Class B, 750 lb. per in. of dia.; and Class C, 800 lb. per in. of dia.

Another phase of the wheel service problem in which car men are directly interested is shop practice. Postwar service is going to require the very best shop practice. Even though the wheels may be right for the service, if they are properly machined and mounted, service performance will not be satisfactory. We all recognize that great improvements have been made in wheel-shop practice. The A.A.R. Wheel and Axle Manual has served as a most helpful guide and the A.A.R. inspectors who are now surveying the shops are doing fine work, but nevertheless I think most wheel-shop foremen will admit that they still see continued evidence of questionable shop practice, such as tapered wheel seats, mismated wheels, poor wheel fits, etc.

My own observation has been that much of this poor practice can be traced to inadequate machine tools. Much of the wheel-shop equipment is old and obsolete. New machinery of modern design should be provided to do the kind of work which will be necessary. Many old wheel lathes will not turn wheels truly round. Axle lathes will not do a proper job on the wheel seats or journals; boring mills will not bore wheels centrally, regardless of constant checking. Now is the time to replace this old equipment so as to be ready for the post-war period.

A major point which I have always fought for is that of providing true rotundity in wheels. The higher the speed of operation, the more vital this is. I have seen repeated proofs of this, particularly in passenger-car operation and the same applies when freight-car operation is speeded up. Wheels must be truly round when applied and must be maintained in this condition. For this reason I have always advocated grinding after mounting regardless of whether the wheels had turned treads or otherwise. If grinding machines are not available wheels should be swung in the lathe and a light cut taken. The new type grinding machines which are set at floor level make this operation simple, quick and inexpensive.

Better riding, less wheel sliding, less wear and breakage of truck parts and less hot boxes, will be the net result of keeping wheels more truly round.

From an expense viewpoint, the exact mating of wheels is most important. An analysis of wheel removals indicates that about 40 per cent of the wheels are turned for sharp flange. Sharp flanges result from a number of causes but the predominant one is difference in diameter of the two wheels when they start in service. The ideal mark to shoot at here is to mate within .005 in. of equal diameter. Ordinary taping permits of only half-tape size mating, but this is not in my opinion sufficiently accurate, particularly for high speeds. Poor center-plate lubrication also increases flange wear, and also trucks out of square, but I think that if you mate wheels accurately, 75 per cent of the sharp flange development can be eliminated.

(*Continued on page 155*)

* Excerpts from a paper on this subject presented before the December 11 meeting of the Car Foremen's Association of Chicago.

† Chief engineer, Technical Board, Wrought Steel Wheel Industry, Chicago.

Higher Boiler Output—

Increased Cinder Cutting*

By E. E. Owens†

IN his introduction the author reviews the history of the growth of the size of the steam locomotive and the steady increase in the demands on the boiler for the past forty years.—EDITOR.

The 4-12-2 type locomotives on the Union Pacific were built with 99.98 sq. ft. of grate area, 220 lb. working pressure, 259 3½-in. tubes and flues 22 ft. long, stoker fired end equipped with Type E superheater and feedwater heaters. These were the largest freight locomotives ever built for use on our property and enginemen were at first reluctant to work them to capacity for speed. There was no cinder cutting damage to firebox sheets, staybolts or flues, but the life of netting, blowers, stacks, and plates in the front end was reduced quite noticeably. It was necessary to change the netting in three to four months, blowers and stacks at 120,000 to 150,000 miles. We obtained up to 150,000 miles before it was necessary to change flues and then it was not due to cinder wear.

In 1927 and 1928 demands for faster movement of freight increased the speed of all trains, and cinder cutting developed at the firebox end so that at 85,000 miles it was necessary to renew 96 to 100 flues in the cinder-cutting area at the top center of the back tube sheet. At 120,000 miles it was necessary to change all the flues, the back tube sheet and 150 to 200 crown stays over the arch. The life of the netting was reduced to 60 days, blowers and stacks to 8 to 10 months. Holes were also cut through superheater units where cinders deflected around the support bands and through the riser shields.

In an effort to reduce these damaging effects we lowered the arch tubes at the door-sheet end 8¾ in., increased the length of the brick arch from the Gaines arch wall back to eight courses, allowing 125 per cent of the gas area through the flues between the top of the arch and the crown sheet; did away with the cap brick on top of the Gaines arch wall; increased the air opening between the ashpan wing plates and the mud ring from 12 to 13 per cent of the grate area; did away with face-plate netting clean-out doors at the sides of the ash pan along the mud ring; applied instead solid plate doors from the ash pan wings up to even with the mud ring, with a 7-in. opening between the face of the clean-out doors and the wrapper sheet.

Crown-sheet and crown-stay cutting were eliminated. The life of the flues and tubes was increased to 120,000 miles before changing any in the cinder cutting area. At this mileage we now change 96 to 110 flues and tubes and continue the engine in service up to 200,000 miles before changing flues and tubes and the back flue sheet.

A program was started in 1928 converting the Mallet compounds to simple articulated locomotives. With the increased capacity thus brought about cinder cutting has developed to the extent necessary to remove approximately 28 5½-in. flues and 50 2¼-in. tubes at 35,000 to 40,000 miles and to renew all the flues and tubes and back flue sheet at 80,000 miles, as compared to no cinder cutting damage to the fireboxes and 80,000 to 100,000 flue miles prior to converting.

To date we have found no arrangement of brick arch which will reduce this cinder-cutting action. We have experimented with the front end arrangement, both with multiple-jet nozzle, with labyrinth front-end arrangement, and with the Master Mechanics' front end arrangement. Increased speed and tonnage and the additional coal consumed result in an excessive amount of unburned fuel and cinders passing through the firebox at a velocity we as yet have been unable to control.

At this time the speed made by the Santa Fe type locomotives was stepped up and cinder cutting developed.

The 4-8-2 type passenger locomotives were crowded into higher speeds and required to haul an additional car or two. This resulted in developing cinder cutting in fireboxes, flues and tubes, units and other parts.

Similar changes to those made in the 4-12-2 type were made in the 4-8-2 type passenger locomotives. The results were not as good as were obtained in the 4-12-2 type locomotives, but there was some improvement. One of the fireboxes in this class of power was equipped with the Security circulator, and the results obtained in reducing the cinder cutting were very satisfactory.

During this period all of this class of power was equipped with a new front-end arrangement, discarding the Master Mechanics' front end, Sweeney-type exhaust nozzle and small-diameter stack, and installing a four-jet exhaust nozzle, a large-diameter stack and blower and a labyrinth front-end arrangement. To improve combustion the firebox sides were equipped with air ducts. engines were also equipped with 12 per cent Firebar grates. The results of the above modifications were a more powerful locomotive capable of hauling another car or two at higher speeds. This, in turn, resulted in a decided increase in cinder-cutting action which damaged flues, tubes, back flue sheets, superheater units, front-end plates and smokebox fronts.

However, the locomotive of this type which is equipped with the Security Arch Company's circulators still continues to give satisfactory performance after modifications made to the front end in May, 1941. At this time, flues have made approximately 260,000 miles and it is estimated that we will get another 75,000 to 100,000 miles without trouble as compared with 100,000 to 110,000 flue miles in the cinder-cutting area and all flues, tubes and back tube sheets renewed at 225,000 miles.

The 2-10-2, 2-8-2 and heavy 4-6-2 type locomotives have all had similar changes, with the same satisfactory results of greatly improving the capacity of the locomotives and the same disastrous cinder-cutting damage to fireboxes, flues, tubes, units and front ends.

Our 4-8-4 type passenger locomotives built in 1937 have 100 sq. ft. grate area, 201 2¼-in. tubes, 58 5½-in. flues 20 ft. 6 in. long, 300 lb. working pressure, Type A superheater and Standard BK stokers. These engines carry an arch with 125 per cent flue gas area between the top of the arch and the crown sheet, four-jet exhaust

* Abstract of a paper prepared for the 1944 Proceedings of the Master Boiler Makers' Association.

† General boiler inspector, Union Pacific.

nozzles, labyrinth front end arrangement and secondary air openings in the side sheets above the fire bed.

Cinder cutting of flues, tubes, back tube sheets, units and front ends increased to the extent that it was necessary to change part of the flues and tubes at 110,000 miles, and all of the flues and tubes and the back flue sheets at 225,000 miles.

In 1939 we built 15 more of these engines. These have 100.2 sq. ft. grate area, 300 lb. working pressure, 50 2¼-in. tubes, 184 3¾-in. flues, 19 ft. long, and Type E superheater. The same area proportions were held above the arch and in the front ends as in the earlier lot and they were equipped with two exhaust nozzles and two smokestacks. These engines gave the same efficient performance with slightly less cinder cutting of flues and tubes. But we experienced more failures of flues due to cinders cutting holes through the walls of the flues adjacent to the unit supports and bands than on the engines equipped with the Type A superheater. Unit support bands were eliminated about two years ago. This enables us to see the extent of the cinder cutting progressing from the firebox end of the flues and has eliminated the failures.

In 1941 and 1942 our heavy freight power was built. These are the 4-8-8-4 type having a grate area of 150 sq. ft., 300 lb. working pressure, 75 2¼-in. tubes, 184 4-in. flues, 20 ft. long, Type E superheater, Standard MB stoker, seven Security circulators, the same gas-area proportions, secondary air openings in the side sheets, and front ends equipped with two four-jet exhaust nozzles and two smokestacks.

Cinder cutting has caused damage to all the crown stays over the arch and in the radius of the crown sheet the full length of the arch and the combustion chamber; the riser tubes of circulators are cut from the crown sheet down 16 to 18 in. Fire-door side tubes, and flues across the top and down each side of the flue sheet are cut. A total of 34 flues and 38 tubes were damaged to the extent necessary to change them at 40,000 to 45,000 miles and it is necessary to change all flues and tubes and the back flue sheet at 90,000 miles.

We have prolonged the life of the circulator riser tubes by welding strips of ⅜-in. rod, 1½ in. apart to the back side of the tubes extending from the crown sheet down approximately 22 in.

We have prolonged the life of the staybolts and crown bolts above the arch by fillet welding 3/16-in. or ¼-in. round wire, cut 2½ in. long in the form of a horse shoe, to the sheet ¾ in. to 1 in. back of each bolt head.

In our 4-6-6-4 engines built in 1942 and 1943, cinder cutting to the fireboxes and other related parts is about the same as in the 4-8-8-4's; it does not develop at such a rapid rate, however. We are protecting the crown stays and staybolt heads and riser tubes of the circulators by welding on shields similar to those applied to the 4-8-8-4 fireboxes and circulators.

Cinder cutting of crown sheets and bolts seems to be governed by height and length of brick arches in engines having fireboxes up to 184 in. long, 108 in. wide, and combustion chambers up to 76 in. in length, and working pressures to 220 lb.

Cinder cutting or crown sheets, bolts, flues and tubes, and flue sheets can be retarded by the application of Security circulators in fireboxes up to 126 in. long, 96 in. wide with 76-in. combustion chambers and working pressure of 200 lb.

Cinder cutting of crown sheets and crown bolts above the brick arch in fireboxes up to 235 in. long, 96 in. wide, 106-in. combustion chambers and 250 to 300 lb. working pressure can be controlled by the application of shields back of the bolt heads.

Wheels for Postwar Service

(*Continued from page 153*)

If wheels can be worn evenly in treads, wheel mileages will be nearly doubled and a large saving made possible.

Incidentally, the accurate wheel work which I have mentioned will also help in cutting down hot boxes. Wheels which crowd to one side, producing sharp flange, cause rubbing of the journal brass against the axle collar or fillet. It has even been recommended that some A.A.R. rule be made to require the removal of wheels which have so-called double flange on one side, which in turn means a rapidly wearing flange on the opposite wheel. Wheels which are out of round tend to bounce more or less and this increases the chance of waste grabs.

Improved shop practice through the use of better machinery and close supervision will improve post-war operation and effect large economies in wheel costs.

I have been engaged in testing of railroad materials and devices in one way or another nearly all my working life. Accelerated tests in laboratories have their drawbacks because there is always some question as to whether service conditions are actually reproduced. On the other hand, road tests have their drawbacks because of difficulty in keeping records and the interference caused by operating conditions and requirements. I have felt for many years that it would be a great thing if the A.A.R. had a section of railroad for testing purposes only. If about 30 miles of track could be built in the form of a circle or a figure eight loop, equipped with necessary instruments, laboratories, etc., it would be possible to make acceleratаed tests of important railroad materials, such as rail, fastenings, ties, ballast, trucks, wheels, axles, brake shoes, etc.

If the often duplicated costs in many individual laboratories and road tests could be reduced by this central testing plant, the information from which would be available to all railroads, there would probably be a saving over present practice.

One by-product of this war period which has been a definite advantage to both wheel makers and users has been the standardization of designs of wrought-steel wheels. Formerly there were about 450 designs of steel wheels for all classes of service. This was reduced to 34 standard designs and 24 standards for use only on existing equipment and which will be unnecessary on equipment built in the future. There are also a considerable number of designs necessary for use with A.S.F. roller-bearing units which were not originally designed for use of wrought-steel wheels. Most of these will probably become unnecessary before many years. Storekeepers, as well as shop foremen, will recognize the advantage in reduction of stocks of wheels by the standardization. Correspondence has also been cut down in the ordering of wheels.

I sincerely hope that after the limitation orders of the government are removed, the railroads will not fall back into the old practice of paying little or no attention to standardization. There will, of course, be times when some new standards will be necessary; on one desires to block progress. These should not be governed by the whim or fancy of some individual engineer, but should be reviewed by the able committees of the A.A.R. and either found necessary or unnecessary. I appeal to you as railroadmen in your own best interests to do whatever you can to hold to reasonable standardization of wheel design. (Mr. Ripley here presented a number of large charts illustrating standard taper versus cylindrical tread contour, reclamation of one-wear wheels, spacing of wheels for various services, etc.—EDITOR.)

EDITORIALS

Keep Up Inspection Standards

Recently a car foreman, in discussing his need for additional help, said that his greatest need was for some "depression days" car inspectors. He recalled the days when A. A. R. car billing often represented a substantial income and he wanted more of the type of inspectors who were accustomed to checking cars thoroughly.

That this need extends throughout the country seems apparent from the number of times within the past year when the Mechanical Division found it necessary to call on A. A. R. member roads for greater care in inspecting cars. Many cars have been found arriving at terminals under load although they were in unserviceable condition because of defective floors or stringers, broken or corroded body bolsters, broken, bent or otherwise defective center sills, broken, bent or weak side sills, and broken or corroded cross-bearers. Repeated attention has been directed to giving proper inspection and lubrication to journal boxes. Special instructions have been required to attempt to have close inspection given to truck bolsters and side frames which have been failing under service conditions although the cracks which caused failure have been disclosed in many cases to have been of long standing and located where they were discoverable. Mechanical Division circulars on inspection and repair of tank-car equipment have been numerous.

Many of the defects to which the various circular instructions refer formerly called for shop tickets which took cars out of service either for light or heavy shop attention, most of the others required some time on the rip tracks. Now such cars are running in such numbers that general instructions are needed to call attention of all roads to them. The lack of a sufficient number of trained inspectors probably accounts for many defects going uncorrected at the time when correction is first needed. Whether this lack accounts for all of such cases is questionable; urgent need of cars probably causes many to be loaded without any inspection, time limits on delivery of loaded materials often leads to temporary blindness when setting a car out of a train would be required for correction of a seemingly minor defect and a general slackening of maintenance standards may mislead inspectors as to what should be passed and what must be attended to immediately.

This last, it seems, is most important when the bad-order percentage of the past several years is considered. As low at one time recently as two-and-a-half per cent, it is currently at three per cent. This does not mean, however, that the freight-car inventory of the country is in the best condition of its history. Standards have been lowered. Care must be taken to see that safety does not become involved.

As standards of maintenance decline it will be more than ever important that the standard of inspection remain as high as it is possible to keep it. Responsible supervisors must make still further efforts to see that men at inspection points understand what conditions must not, under any circumstances, be allowed to get by. The extent to which supervision is successful in doing this will determine largely how long the railroads can continue to keep the present high percentage of their cars in service.

Status of Train Communication

In making frequency allocations to the various classes of non-governmental services in the radio spectrum, the Federal Communications Commission has shown fairness, thoroughness and broad understanding. The railroads have accepted the Commission's proposals with requests for only minor changes. The principal one of these is that they be allowed 100-kilocycle rather than 60-kilocycle band widths in the 156-162 megocycle range, since under the present development of high-frequency communication equipment the narrower band would increase costs and operating difficulties.

The Commission's record justifies the assumption that it will continue to cooperate with those agencies which make adequate use of their assignments. There is good reason to believe the railroads will do this. Some of them will probably make extensive applications, with full knowledge that future developments may indicate the desirability of their moving into another part of the radio spectrum.

Aside from needed technical developments, there remains also the need for working out operating rules. Manifestly, it would be impracticable to require that all users of train telephones be licensed radio operators, but trainmen, etc., will require some kind of certification to show that they understand operating requirements and know the limitations of conversation which can be put "on the air." If such training of operating personnel can be conducted by the railroads to the satisfaction of the Commission, much time and traveling can be avoided. Licensed technicians will, of course, be required who are capable of maintaining transmitter outputs within prescribed channels.

Another situation which needs clarification is one

which has been created by two railroads making application to the Interstate Commerce Commission for permission to install train communication. The I. C. C. passed on these applications with formal orders. When a railroad makes such a request, it would be less than courtesy for the Commission to ignore it. On the other hand it would appear from a reading of Section 25, known as the Signal Inspection Act, of the Interstate Commerce Commission, that it was not intended to include communication systems. It is expected that other roads will make no such application and if this also meets with I. C. C. approval, a situation which has caused some disturbance among prospective users of train communication will be clarified automatically.

Once these questions are disposed of, and the Federal Communications Commission has made its assignments, rapid progress can be expected. Much useful technical information is already available, and with freedom to act, the railroads which have declared their intention to use train communication will be in a position to make free choice of various types, including both space radio and inductive systems.

Undesired Emergency Brake Applications

At the December 18 meeting of the Northwest Locomotive Association in St. Paul, Minn., considerable pertinent information about the operation of airbrake equipment, particularly in high-speed service, was presented. Following the principal paper by R. G. Webb, superintendent of air brakes, Chicago, Milwaukee, St. Paul & Pacific, one of the points emphasized in the discussion was the perennial question of how to locate a "dynamiter", or car subject to undesired emergency brake action, in a long freight train after it is stopped. An associated question related to what method of brake handling, if any, can be used to prevent a known bad-acting car with this particular defect from disrupting train operation by going to emergency when a service brake application is made.

Experience has apparently failed to develop any infallible means of locating a dynamiter on the road unless there is a blow at the retainer or through the valve, or the brake fails to function normally in conjunction with other cars of the train. Even cutting the train into small sections and making a series of brake-pipe reductions appears to be seldom successful in pointing out the defective car, primarily for the reason that train-line pressure, leakage and other factors which may have a bearing on undesired emergency brake action in a long train are not the same in a short cut of cars.

When the presence of a car subject to undesired emergency brake action is suspected in a train, the enginemen on many roads follow the practice of slightly overcharging the train-line before beginning a service application. The best that can be said for this practice, which is by no means new, is that it sometimes works, but obviously not when the dynamiter is in the center or rear of a long train, for the overcharge does not normally reach that far back in the train. Moreover, while a slightly overcharged train line may help in making a sticky triple valve move, the overcharge in itself tends to promote emergency action and the building up of brake cylinder pressure in other cars of the train which have normally functioning brake equipment, including Type AB.

In questioning the necessity or desirability of the practice just described, Mr. Webb made the following pertinent comments: "If the car that is causing the trouble is near the head end of the train, and the cause is a sluggish operating valve, of which we have a few, then by overcharging the brake-pipe just before the application it is possible that the slide valve will be moved to retarded release position, breaking the static friction just before the valve is moved to application position. Our yard masters and shippers are not sufficiently mechanically minded, however, to look at a car and say, 'Here is one that will have to be placed in the forward end of the train as the valve is sluggish in operation and it is necessary for an overcharge to take place in the brake-pipe before application in order to keep the valve from going into emergency.' I do not blame the enginemen for resorting to somewhat unethical means in trying to prevent emergency for there is a lot of satisfaction in doing a job well, and a dynamiter in a train is certainly an annoyance. It is a mistake, however, for these men to fix in mind the thought that the brake-pipe should be overcharged before making a service reduction with a freight train. . . . When we overcharge the brake-pipe, naturally we also overcharge the auxiliary and emergency reservoirs, and upon release of the brakes after an overcharge, the overcharge from the emergency reservoir builds up the auxiliary reservoir beyond the brake pipe and in turn finds its way into the brake cylinder.

"In former days, we were told to make a kick-off in order to get rid of the overcharge. With the Type-K triple this is fairly successful. However, with the Type-AB brake, this feature is omitted, and I know of only two ways to get rid of an overcharge on the AB. The first is to make several reductions and releases with the automatic brake valve. Just how successful you will be in doing this depends entirely upon the amount of overcharge and the length of the train. The second and sure way of getting rid of the overcharge is to bleed the car.

Further discussion of ways and means to avoid undesired emergency brake action developed a concensus in favor of starting brake applications sooner and making them lighter instead of throwing the brake valve handle quickly to service position and making a heavy reduction of 10 to 12 lb. to secure the desired reduction in train speed. Experience seems to show that enginemen who have the least trouble with unde-

sired emergency anticipate their braking requirements so that the first application may be a light reduction of possibly 6 lb. in brake pipe pressure, followed by additional 2-lb. or 3-lb. reductions as required.

Undesired emergency brake action is sometimes caused by excessive brakepipe leakage when trains are negotiating a curve or crossover and the loss of air at couplings combined with a service reduction brings the rate of fall of brake pipe pressure within the emergency zone. In the main, however, dynamiting is due to stuck valves, or valves with restricted service ports, of the older K type and can be practically eliminated by better air-brake maintenance practices in accordance with the more rigid test code now in effect. Owing largely to war conditions, only about 50 per cent of present freight cars are equipped with AB brakes and, since the designed capacity of Type K brakes is exceeded in modern long trains, this equipment must be maintained to somewhat higher standards if it is to function successfully in conjunction with the improved standard AB brake.

How High A Price Can We Afford to Pay?

Recently a new type of steam locomotive was turned out of a builder's plant with appropriate ceremonies at which a number of newspaper men were present and when the party was over and everybody went home one of these newsmen, a columnist for a suburban newspaper, took the locomotive as the subject for his column the following day. He made an honest appraisal of a number of things, admitted that he knew nothing about locomotives except that as a small boy he was always fascinated when he saw them come roaring down the track and then ventured the personal opinion that he hoped some people were wrong when they predicted the untimely end of the steam locomotive. He liked the looks of an electric or a Diesel locomotive, he said, but they didn't cause his blood to run any faster when he saw them coming. He also knew that among railroad men there was considerable controversy as to which type was the best. He had, he said, been taught, as a boy, that it was next to impossible for people to make a living by taking in each other's washing but he was suspicious that among the major reasons why many railroads were deeply interested in perpetuating steam as a form of motive power was because the railroads made a pretty good living hauling each other's coal around. When it is considered that about one-quarter of the bituminous coal mined is used by the railroads it certainly is not difficult to understand that the railroads and the mining industry have one or two interests in common.

This newsman touched upon a very important factor in this matter of the development of motive power for the future. If the railroads, the coal industry or the builders, individually or collectively, are going to approach the matter of research, so to speak, in the subject of the steam locomotive primarily on the ground that for individual interests a way must be found to keep it in existence they are approaching the problem on an economically unsound basis.

The railroad executive of the future is going to be faced with keen competition in the transportation field and if he is an intelligent railroad man he will know his job so well that he will be interested only in that form of motive power that will do the job at hand most efficiently and economically. It will make little difference to him whether his trains are hauled by electric, Diesel, steam turbine, gas turbine or reciprocating steam locomotives. The chances are that on most large roads at least all of these types will be doing the work of the future. But the important thing that must be kept in mind is that the final selection of motive power is as much a matter of economics as it is of engineering factors. If it isn't sound economically it doesn't make much difference how well it runs.

This brings us to the point we want to make. We have heard a lot of discussion about thermal efficiency and over-all efficiency and we know that inherently the Diesel-electric locomotive has a higher over-all thermal efficiency than a steam locomotive. But, in order to gain that efficiency it costs more to build and to operate, horsepower for horsepower and mile for mile. Almost every effort that is being made today to improve the efficiency of the steam locomotive is along lines that will increase its first cost. The cost of a 5,500-hp. steam freight locomotive has, several times in individual cases, passed the quarter-of-a-million dollar mark and, as for the turbine types, we do not yet know what their cost will be to the ultimate user. If, in order to develop a steam locomotive approaching the Diesel in efficiency it is going to be necessary to increase its first cost to a point where it practically equals the first cost of a Diesel it will have given up one of its major advantages over the Diesel. If a complexity of expensive-to-maintain parts becomes necessary in order to approach the Diesel's availability the effect upon total operating cost may be such as to wipe out another advantage.

This problem is too broad in scope to encompass within a single discussion but it may be well to keep the above points in mind in attempting to establish our future objectives. The reciprocating steam locomotive has a fine record so far in the matter of low operating cost and its first cost is moderate—we are speaking mainly of modern units built within the past 10 years. Given an even break by the operating department its availability record is far better than the average person thinks. Its real weaknesses lie almost entirely within the boiler—high maintenance costs, water troubles, fire-cleaning delays at terminals. There is hope that the efforts of those groups who are studying this problem may be so concentrated on the problem of a better boiler that the railroads may ultimately have available an ultra-modern reciprocating locomotive that still represents real economy in operation.

THE READER'S PAGE

The L. M. S. Turbine Locomotive

To the Editor:

The authors of the article describing the Pennsylvania's new turbine-driven locomotive in the *Railway Mechanical Engineer* for March conclude with a reference to locomotive practice on the London, Midland & Scottish Railway. The reader is left with the impression that the turbo-locomotive of that railway suffers by comparison with the reciprocating engines used in the same service because the latter are high-powered compounds, super-efficient, yet strangely unreliable. One can only wonder from what source the authors' information was obtained.

It may be stated quite positively that the L.M.S. possesses *no* compound locomotives comparable in power to its turbo-locomotive No. 6202, which is the heaviest 4-6-2 type in Great Britain. All of the Pacific type reciprocating locomotives owned by this railway have four single-expansion cylinders. The heavy 4-6-0 type locomotives, also used extensively on main line passenger trains, are three-cylinder simples. The only compound locomotives now running on the L.M.S. are small three-cylinder engines of the 4-4-0 type, built during the regime of the late Sir Henry Fowler and since relegated principally to secondary duties.

As to the performance of the L.M.S. turbo-locomotive, it has now run more than 250,000 miles in express passenger service, largely on London-Liverpool trains, and may be regarded as quite reliable mechanically. In coal and water consumption per drawbar horsepower hour, it does not differ noticeably from the reciprocating engines employed on similar work. Speaking before the Institution of Mechanical Engineers in 1941 and again in 1944, Sir William Stanier, who was responsible for the design, construction and operation of this locomotive, stated quite plainly that it showed little increase in thermal efficiency as compared with a reciprocating locomotive, because of the absence of a condenser. He also observed that the variable demand upon the locomotive for power prevented the attainment of maximum turbine efficiency, confirming an opinion long held and often expressed by others.

Wm. T. Hoecker.

Curtis Turbine Defined

To the Editor:

On page 99 of the March *Railway Mechanical Engineer* in an article on the steam turbine locomotive built for the Pennsylvania you state that "the forward turbine is of the impulse type and consists of a Curtis stage followed by five full admission Rateau stages."

This mode of describing the turbine is sometimes used, but it is not correct. The fact is that my type of turbine, used by Westinghouse in the above locomotive, is exactly like the one built by the General Electric Company from the beginning, involving the use of a two-row stage with a series of single-row stages. It was described and shown in my patent 566,969 (September 1, 1896) and is covered by the claims therein. This patent was broadly supported by the Circuit Court of Appeals in 1914 and in Judge Buffington's opinion the conclusion was reached that the work done by Rateau was not of practical value, cut no figure in the art, and was not an anticipation of the Curtis patent.

The early turbines designed by William L. R. Emmet and myself involved this combination and the marine turbines designed and built by me at the same time also involved the combination, as have all these built by me at the same time also involved the combination, as have all these built since that time by the General Electric Company and by our licensee, both in the land and marine fields.

Chas. G. Curtis, President,
International Curtis Marine Turbine Company

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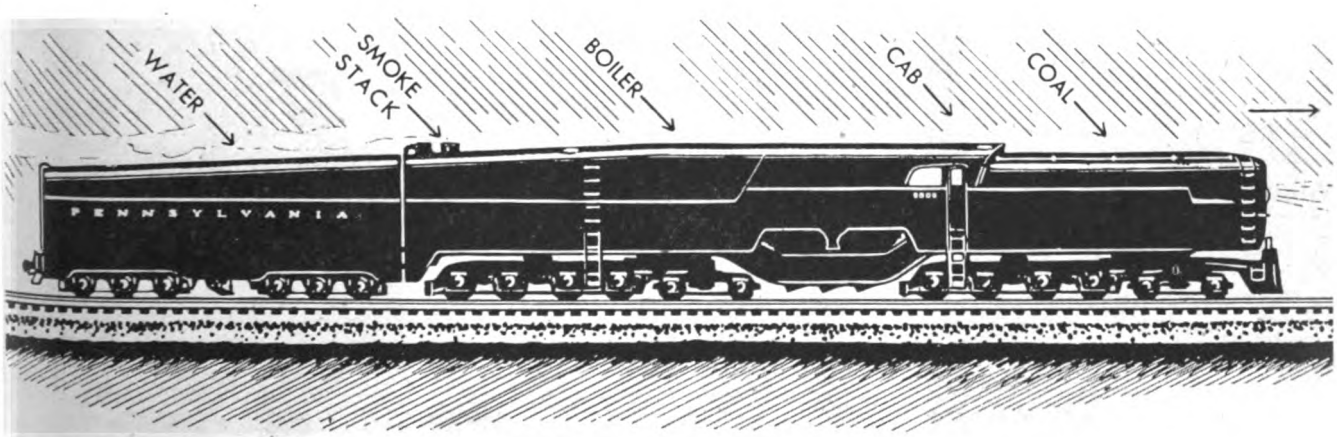


The Pennsylvania designs another steam-turbine locomotive

Known as the Triplex, Class S-2, with coal bunker ahead of the boiler on the same cast-steel frame, the locomotive will be driven by two geared steam turbines, one on each of two swiveling trucks with four driving axles each. The turbines will develop 9,000 hp. Water from the tender will replace coal, as it is burned to maintain constant adhesion. Water capacity, 21,000 gals.; coal, 32½ tons; total wheel base, 122½ ft.

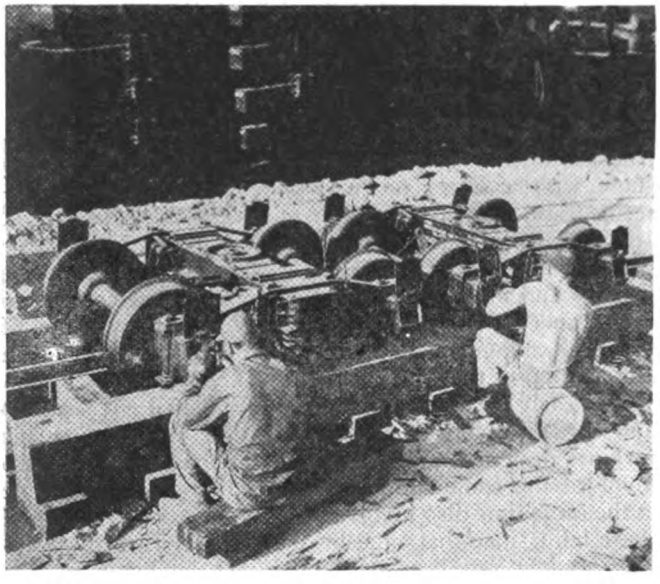
With the Car Foremen and Inspectors

Assembling Narrow-Gauge Cars at Hawaii

Narrow gauge railway cars, used to carry supplies at an Hawaiian Island naval base, are being assembled at the rate of 8 to 10 cars a day by a Navy Seabee battalion which operates an effective assembly line to handle the job.

Except for size, the 30-ton capacity steel cars, 38 ft. long by 7 ft. wide, involve the same general construction as standard cars used in the United States.

To conserve cargo space the cars are shipped to Hawaii dismantled. The frames arrive with flooring already in place, but all draft-gear assemblies, stake pockets, sides and other parts have to be installed by the Seabee assembly crew, only a few of whom have had prior railroad experience.



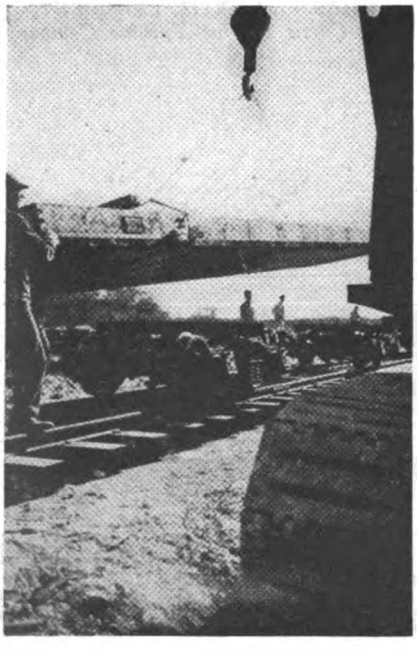
Lack of proper tools and facilities for the job necessitates unusual methods of procedure. Commander Eugene C. Lang, Civil Engineer Corps, U. S. N. R., of Geneva Road, St. Charles, Ill., officer in charge of the battalion, whose pre-war experience as a general consulting engineer in Chicago included some more or less extensive observation of American railway car-shop operations, has successfully developed and applied the idea of turning the beds of the cars upside down on the trucks, installing the necessary parts in this more accessible position, then turning the beds over to their proper position to complete the operation.

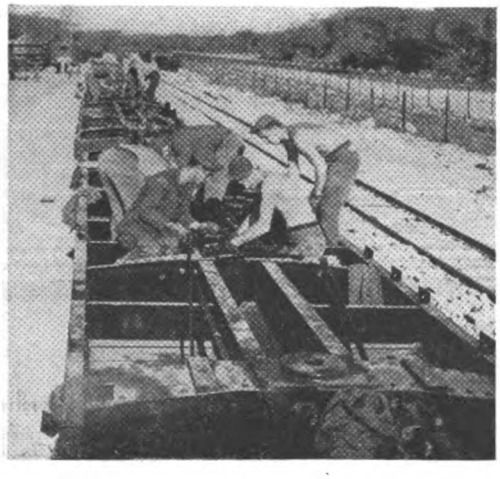
First, 1,000 ft. of railroad track was constructed, with enough space to accommodate 15 cars on the assembly line. Then a completely assembled car was made up and set aside to serve as a model. This model makes it unnecessary for the men to refer frequently to blueprints, and has the added advantage of showing clearly how and where each part should be installed.

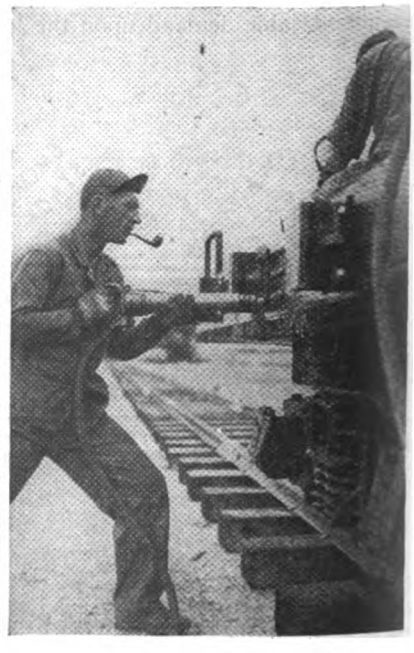
The assembly line, in which seven major operations are carried out, assures an orderly procedure and conserves both time and labor in performing the various assembly operations. The line is designed to employ 56 men, but this number may be varied without slowing down production to any appreciable degree.

In the first operation, the trucks are serviced, journal bearings and wedges being applied while the trucks are supported in a slightly elevated position with the journal boxes resting on 10-in. by 12-in. timbers, as shown in one of the illustrations. The trucks are then lifted off the timbers and moved into position on the assembly-line track.

In the next operation, a Northwest gasoline-operated





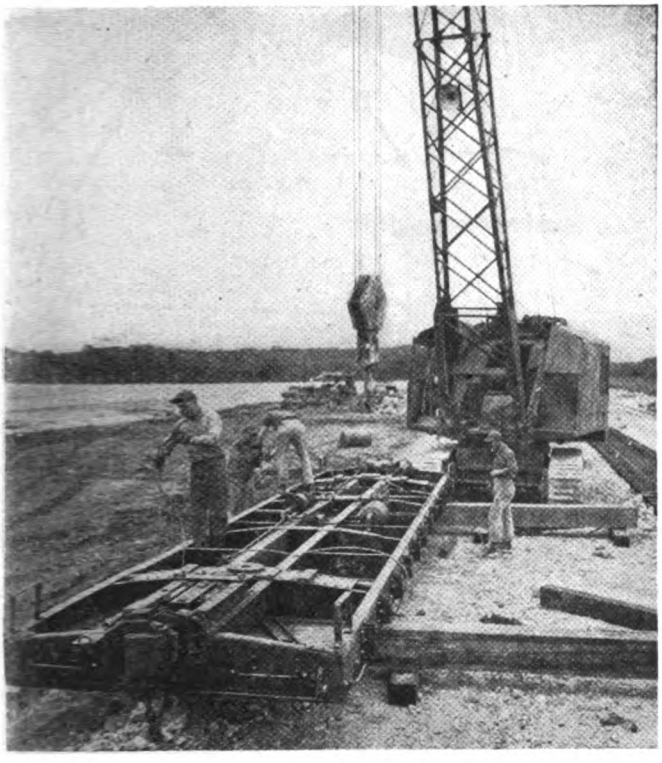


Above left: Assembling narrow-gage freight car trucks at Hawaii—Left: Placing car bed upside down on timbers laid over truck bolsters—Below: Looking down the assembly line—Right: After parts are temporarily secured with bolts, riveters replace the bolts with rivets

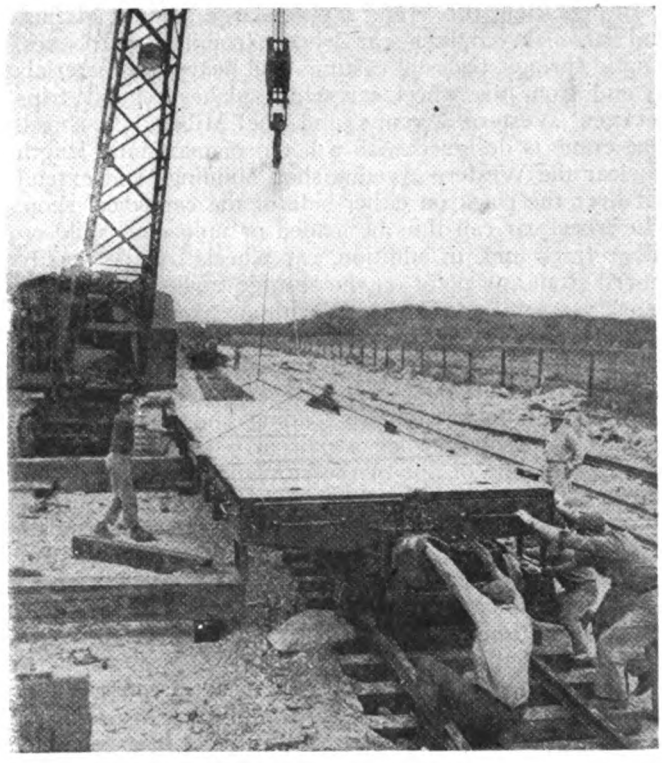
crawler-type crane lifts a car bed from the stack beside the track and lowers it, upside down, to rest on two timbers laid on top of the truck bolsters.

Draw bars, complete with draft gear, and coupling bars are installed, after which the car is pushed along the track by a small bulldozer. Supply men unpack and sort bolts, nuts and parts, and place the required items on the inverted car bed, ready for the crews to install.

The main assembly is done in the third operation,



Above: A Northwest crawler crane is used to place bed on long timbers—Below: Turning the bed right side up



Mounting the car bed in position on the trucks preparatory to final painting and testing

where a crew installs the brake mechanism, grab irons, stake pockets and sill steps before the car is moved up to the riveting crew. All the required riveting is completed at the fourth position, with the aid of air-guns and an oil burning unit heater, installed on the site for heating rivets in quantity.

The fifth operation is the final assembly, where the car bed is lifted by the crane, turned right side up, and lowered into place on the king pins of the trucks. Brake hand wheels, side boards and air hose are then installed. The necessary stenciling and painting is done at the sixth position and the car is pushed down the tracks to the seventh position for final testing.

Although unorthodox, this method of assembling cars has proved satisfactory and efficient. With few minor changes, both flat cars and gondola cars have been assembled, and the crew is now preparing to assemble box cars by adding another operation to their assembly line.

A Mast Crane With 38 Ft. Swing

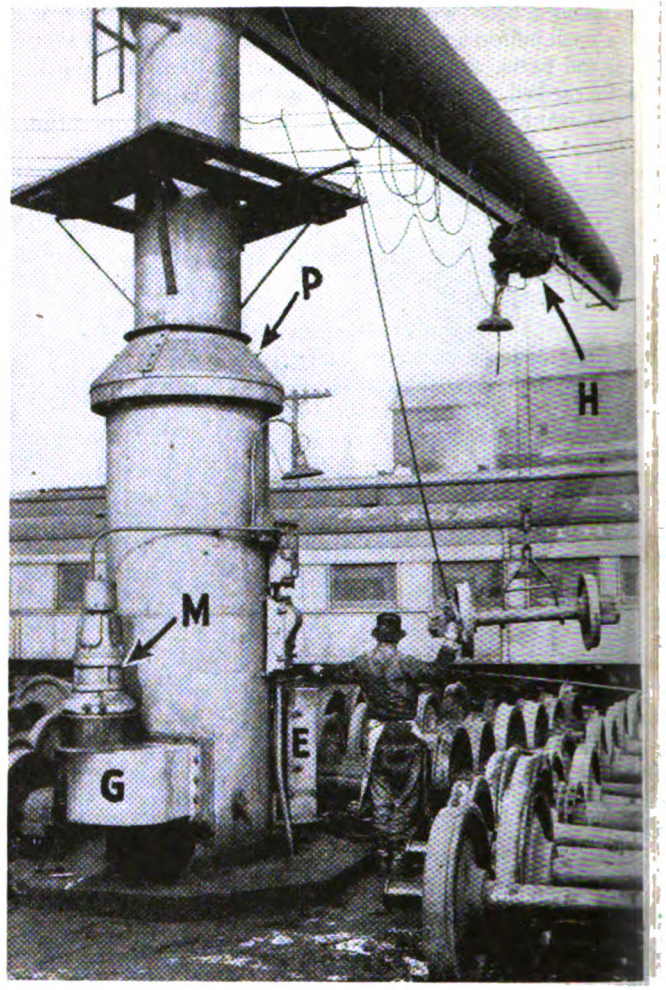
The work of handling car wheels and other heavy materials at the Western Avenue coach yard of the Chicago, Milwaukee, St. Paul & Pacific, at Chicago, is greatly expedited by means of the large mast crane shown in the illustrations. This crane incorporates welded tubular steel construction throughout, with a 40-ft. tapered boom which swings through a full 360 deg. in either direction at an elevation of 20 ft. above ground level and has a lifting capacity of two tons by means of a Harnischfeger traveling electric hoist. Because of the construction of the crane, it is sometimes referred to locally as "Big Bertha." It is unusually rigid and easy to operate and, in over two years of service, has required practically no maintenance.

In operation, this crane saves a large amount of time and labor in handling car wheels, couplers, oil boxes, elliptic springs, pedestal castings and heavy car materials to and from the wheel car which makes regular trips between Western Avenue and the Milwaukee shops. The crane is designed with a boom of maximum length to clear the Western Avenue shop buildings and extend out over the track on either side of the car-wheel shop. The wheel car can thus be loaded or unloaded while on either track and, in addition, car wheels can be readily moved from any point on the storage tracks to the shop delivery track, or vice versa, without manual handling.

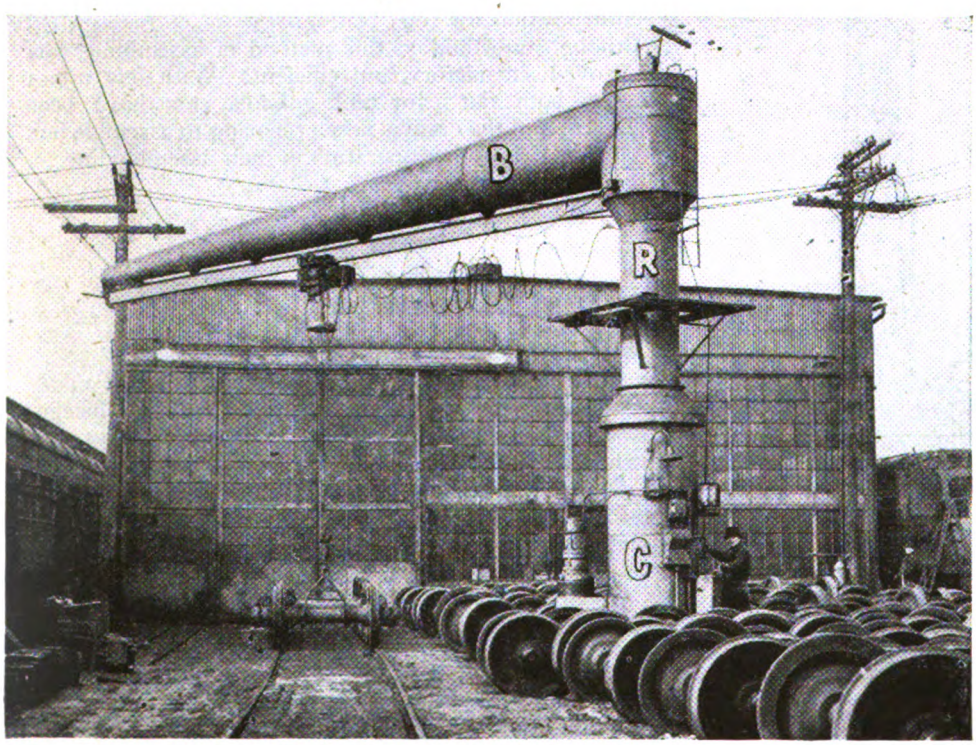
Some idea of what this means in time and labor saving may be obtained by comparing present with former practice when a stationary air hoist and portable wooden platform had to be used in loading and unloading car wheels. Moreover, when a pair of wheels was needed from the middle of one of the storage tracks, all wheels ahead of it had to be moved individually and turned by means of a wheel stick at the transfer track before that particular pair of wheels could be released and run into the wheel shop. Obviously all the wheels moved had to be manually rehandled and rolled back to their original positions so as not to interfere with the next movement on the shop track.

Referring to the illustrations, the general construction of this mast crane will be apparent. It consists of a large vertical welded cylinder *C* firmly set in a concrete foundation, revolving mast *R* and boom *B*. Details shown in the other view include the Harnischfeger 2-ton hoist *H*, taper cover plate *P* which protects the upper roller bearing, electric driving motor *M*, gear box *G* which covers the speed-reducing gears, electric control box *E* and handle (in the operator's left hand) which governs the movement of the boom; also a swinging cable and push-button controller (in the operator's right hand) which controls horizontal traverse of the electric hoist and vertical movement of the crane hook. An electric light fixture, suspended from the hoist, gives good illumination directly over the crane hook which can thus be applied or released without difficulty on the darkest days or nights. Incidentally, this is an important safety feature.

Cylinder *C* is made of three sections of ¾-in. steel plate, rolled and welded to form a cylinder 3 ft. 9½ in. in diameter by 15 ft. 6 in. long. The bottom section,



The boom-revolving motor and electric controls of the C. M. St. P. & P. mast crane



A mast crane and 2-ton electric traveling hoist installed at the Western avenue coach yard of the C. M. St. P. & P. at Chicago

5 ft. 6 in. long, is reinforced with five circumferential ribs for stiffening purposes and to hold it firmly in the solid concrete foundation into which it is imbedded to a depth of 5 ft. The balance of the mast extends vertically 10 ft. above the ground and serves as a housing and support for the mast.

Mast *M*, also made of ¾-in. steel, is rolled and welded to form a 2-ft. 6-in. cylinder approximately 16 ft. long which extends down into cylinder *C* about 7 ft. and is closed at the lower end with a welded steel plate and bushing assembly, designed to house a Timken car roller-bearing and journal-support unit, suitably mounted in a vertical position in the base of cylinder *C* at an elevation slightly above ground level. This roller bearing not only positions the lower end of mast *R*, without restricting rotation, but supports most of its weight on the taper rollers. The bushing referred to is connected to a large spur gear which turns the mast in either direction by means of power supplied from the reversing electric motor *M*.

The upper support bearing for mast *R* consists of a series of fixed center rollers mounted around the exterior of the mast and having as an outer bearing a substantial steel ring welded to the upper end of cylinder *C*. This entire bearing, which takes side thrust of the mast in any direction, is protected against the entrance of dirt or water by means of taper cover plate *P*. For purposes of lubrication ,the entire space between mast *R* and cylinder *C* is filled with about 400 gals. of second-hand car oil which supplies an oil bath for both roller-bearing units. The oil level is maintained just above the upper bearing under cover plate *P* and this means that approximately a 10-ft. head of oil exerts a lifting effect on the lower end of the mast, thus relieving the lower taper roller bearing of about one-third of the 16,000 lb. weight which it would have to carry otherwise.

One of the most interesting features of this crane is the boom which is made of ¼-in. open-hearth steel in six sections, cut, rolled and welded together to form a conical tube, 14 in. in diameter at the smaller end and about 48 in. in diameter at the larger end where it is welded to a 5-ft. vertical steel cap forming the top of mast *M*. As a matter of fact the actual length of the boom is 38 ft. from the small end to the center line of the mast. The top of the mast cap is 4 ft. in diameter, so the total length of the boom may be called 40 ft.

The boom is welded to the mast cap at an angle so that the lower edge of the boom is accurately horizontal. Supported 3-in. below it by welded connections from seven points on the boom is a 10-in. 25-lb. steel I-beam which carries the travelling hoist, with rollers bearing on the two lower flanges. A substantial stop on the outer end of the I-beam limits the travel of the hoist which is traversed horizontally and the hook raised or lowered by remote push-button control near the base of the crane mast as explained.

Ring-type electrical connections are made to the top of the mast, as shown in one of the illustrations, and both views show the steel wire and sliding clip supports for the insulated wires which supply electric current to the hoist motor and to the light fixture attached to the hoist. Other electric connections to the motor and controller which revolve the boom are illustrated. The main mast carries a small scaffold and steel ladder welded to the cap for the convenience of electricians who go to the top for inspection of electrical connections.

The boom of this mast crane swings very easily, smoothly and quietly by operation of the controller handle which has four positions or speeds in either direction. A brake element, built into the base of the main mast, is not normally used as the boom can be easily spotted wherever desired by means of the controller handle, alone. The electric hoist also moves quietly and with minimum friction on its I-beam support and is designed to lift up to two tons.

Air Brake Questions and Answers

HSC High-Speed Brake Equipment for Passenger Cars and A and B Diesel Locomotive Units

269—(Continued)—*Functioning of parts of locomotive equipment during initial charging operation.* A.—With the handle of the MS-40 brake valve in release position, the control pipe *11* is open to the atmosphere through brake valve cavity *B*, past exhaust valve to the exhaust *Ex*. Therefore, chamber *B* of the master controller, which is connected to the MS-40 brake valve by the control pipe, is open to the atmosphere. Spring *40* holds the shaft *32* in release position, where its contact levers hold the application and release contacts open. The application wire and release wire are de-energized. With the application and release circuits open at the master controller on the A locomotive unit, the application and release magnets of the 21-B magnets on the locomotive units and cars are de-energized.

At the 21-B magnet, auxiliary reservoir air unseats by-pass valve and flows to passage *6a*, charging the chamber beneath the application magnet valve. The latter is held seated by air pressure and its spring. The release magnet valve is held unseated by its spring, thus connecting passages *4a* and *x*, opening the air pipe to the exhaust.

At the D-22-ER control valve, air from the brake pipe flows through the branch pipe combined dirt collector and cut-out cock, through the filter *12* and to chambers *A* and *B* on the faces of service and emergency pistons, moving them to release position. With the service piston in charging position the piston head uncovers charging choke *83* and the charging ports *x* in the piston bushing. Brake pipe air in chamber *A* charges the auxiliary reservoir through (a) choke *85* to service slide valve chamber *C*, thence through passage *5g*, release slide valve chamber *D* and passage *5* to the auxiliary reservoir; (b) charging ports *X*, passages *5f*, choke *81*, past check valve *73*, passage *5g*, release slide valve chamber *D* and passage *5* to the auxiliary reservoir, check valve *73* permits charging in this direction but is seated by spring *89* to prevent back flow from the auxiliary reservoir when the latter pressure in passage *5g* is higher than brake pipe pressure in passage *5f*. The slide valve chamber *C* and the release slide valve chamber *D* are connected by passage *5g* so that the auxiliary reservoir pressure is the same in both chambers at all times. Auxiliary reservoir pressure in chamber *C* is also connected to the spring side (chamber *K*) of the release piston, through port *a* in service slide valve and passage *a1*. With the air pressure acting on the release piston balanced, spring *116* moves the piston and attached slide valve to release position, where cavity *Q* in the slide valve connects the displacement reservoir passage *3b* to exhaust passage *10*. The emergency reservoir is charged simultaneously with the auxiliary reservoir from the release slide valve chamber *D*, through passage *2c* at the right end of the release slide valve, passage *2f*, past ball check valve *195* and flat check valve *73c*, passages *2k* and *2a* and pipe *2* to the emergency reservoir. Spring *89c* is overcome and check valves *195* and *73c* are unseated, permitting this charging flow as

long as auxiliary reservoir pressure is higher than emergency reservoir pressure, but when the emergency reservoir pressure is higher it seats the check valves and prevents back flow from the emergency to the auxiliary reservoir. In the emergency portion of the D-22-ER control valve the brake pipe air in chamber *B* on the face of the emergency piston flows through the charging choke to chamber *E* on the slide valve side of the piston and through the passage *4* to the quick-action chamber. With the pressures thus equalized on both sides of the piston it remains in release position.

At the FS-1864 or F-1864 relay valve on locomotive units, pipe *16* is open to control valve passages *16, 16c* and *16d,* past double check valves *263* and *263s,* passage *8a,* cavity *n* in slide valve and passage *8* to the straight air pipe, which is open to the 21B magnet valve exhaust. This connects diaphragm chambers *P, N, K* and *A* of the relay valve through passages *19, 18, 17* and *16a* to the magnet portion. With the *M, L* and *H* magnets de-energized, passage *19* is connected past the upper magnet valve *161b* and choke *138* to passage *15*; and passages *18* and *17* past lower magnet valves *161* and *161a,* and chokes *140* and *142* to passage *15.* Passage *15* is connected past unseated supply valve *92* and passage *16c* to passage *16.* As passage *16* is connected to the 21-B magnet valve exhaust, the diaphragm cavities *P, N, K* and *A* are exhausted and the piston spring holds the diaphragm assembly released. All pressure is thus released from lever *43* which floats freely, permitting the exhaust piston and its valve to remain open, releasing the air from chamber *F* and connected brake cylinders to exhaust *Ex.*

At the FS-1864 relay valve on the A unit, chamber *A* of the switch piston is open to atmosphere. Spring *9* releases collar *6* which disengages finger *20* from contacts *28* and *28a,* thus opening the battery circuit to the speed governor relay cabinet.

Cleaning and Testing Pistons of AB Brakes

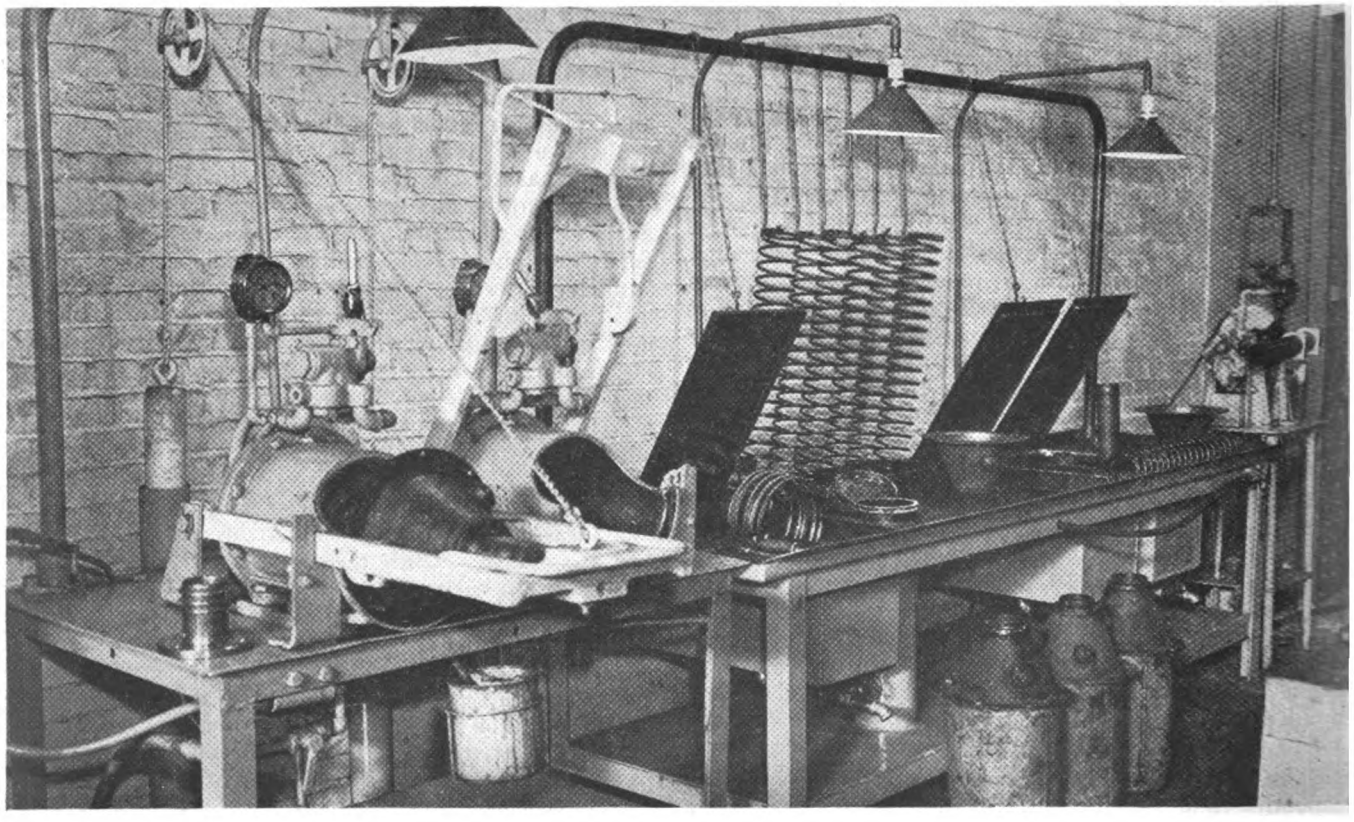
A combination cleaning, spring-testing and gasket-lubrication table for the reconditioning of AB brake pistons which was designed by the shop air-brake foreman has been installed at the Reading freight-car shop at Reading, Pa. The tables makes possible the centering of cleaning, testing and other operations in one location which is close to the working tracks where cars requiring attention to the AB brakes are undergoing repairs.

In the course of overhauling these brake parts the springs are first thoroughly cleaned, all rust spots are removed, and they are given a bath in japan drier. After being dipped in the drier they are hung on a railing to dry. The japan drier is used as a rust preventative and gives the surface of the springs a glazed appearance.

Near the spring cleaner is an arrangement for cleaning swab lubricators. A rack on the lid of the dipping tank, in which these parts are immersed in a special oil, holds the swab lubricators. When the lid is lowered the parts are covered by oil, when the lid is in the raised position the rack holds them above the oil level while excess oil drains back into the dipping tank.

A seal-ring gauge on the edge of the table is used to check all seal rings for correct size and contour.

After the cleaning and individual testing operations the pistons are reassembled on unit test racks where they are checked for proper movement of the pistons and for packing-cup leakage. The photograph shows these test racks, one in the open position and the other with a piston assembly mounted for test. Also shown in the photograph are three of the special metal carriers which are bolted fast to the non-pressure head and serve as a protection to those parts when they are being moved to cars for application.



Cleaning, overhauling and testing of AB brake-cylinder pistons take place at this compactly arranged working location in the Reading freight-car shop at Reading, Pa.

Selecting Carbides for Milling

By Fred W. Lucht*

When starting a new milling operation with carbides—or when changing from high speed steel to carbide tipped cutters—an inevitable problem is the selection of the proper grade of carbide from among the many available. Increased knowledge as to the other factors contributing to good results, however, has so simplified grade selection over what it was a few years ago that today, a total of five "grades" of carbide as produced by Carboloy suffice to give optimum performance and cutter life over virtually the entire range of milling jobs. This holds true, of course, only if the basic requirements of good carbide milling practice are observed.

Grinding and Cutter Design Are Important

Cutter sharpening is one of the factors which can make or break any carbide milling application. In general, carbide removal per wheel pass should not exceed 0.0004-in. for rough grinding; 0.00015-in. for finish grinding. Enough carbide must be removed from each worn cutter tip to get down to good solid metal again, but any attempt to remove too much carbide at a single pass of the wheel may result in heat checks which will ruin even the best grades of carbide. Examination of the ground surfaces through a magnifying glass of 20 or more magnifications will usually show how much carbide metal should be removed. If insufficient stock has been removed, fine, hair-like lines will appear on the carbide's surface. These lines will cross the cutting edges at several points. Cutter life will be materially shortened if enough stock is not ground off since these hair-like lines afford excellent points for starting the breakdown of the cutting edge.

Perfect grinding practice, however, will not offset incorrect cutter design. For instance, double negative angles should be used in most cases when milling steels and tough, hard cast irons. Present indications are that cutters with 10 deg. negative axial rake and 10 deg. negative radial rake will give best results when milling the harder steels; whereas 5 deg. positive radial rake angles can be used for soft steels. Furthermore, enough chip room should be provided in the cutter so the chip will not heat up and get sticky, a condition which may result in the chip's being pulled through a second time to the detriment of the cutting edge.

Setup conditions of the specific job—particularly as they affect rake angles—should always be taken into consideration when designing a carbide cutter. Since negative rake angles are used to keep the chip load away from the cutting edge and the nose, the axial rake angle should be large enough so that the impact load is taken at a distance equal to the depth of cut away from the cutter face. The impact load should also be taken at a distance from the peripheral cutting edge on the tooth face equal to the chip thickness.

Since it is possible to put negative angles on the cutter and yet—due to setup conditions—have the load come on the cutting edge or nose as the tooth enters the cut, it is good practice to check the cutter setup and make sure that the actual effective angle between cutter and work is in line with the desired rake angles.

Feeds and Speeds

Feed per tooth should be high enough to avoid concentration of chip load near the cutting edge. Optimum feed per tooth for milling steels has been found to be between 0.008 and 0.012-in. Best cutting life is usually obtained when the cutting edge enters the cut with a thick chip. Chip thickness is at its maximum and equal to feed per tooth when the edge of the work where the cutting edge enters it is at the cutter center line parallel with the direction of feed. If the work is moved in either direction at right angles to the direction of feed, chip thickness will gradually decrease.

Too high speed increases carbide wear; whereas speeds which are too low cause a built-up edge to form, resulting in poorer finish and reduced cutter life. A steel having a Brinnell hardness of 110 seems to be milled best at about 750 surface ft. per min. Heat treated alloy steels with hardness as high as 400 Brinnell will mill best at about 360 surface ft. per min. Varying speed with hardness in this manner has been found to give the longest life of carbide cutters.

The use of flywheels on milling machines gives two definite advantages, particularly when milling at high speeds. A flywheel damps out chatter and high frequency vibrations in the cutter drive resulting from changes in load as the individual cutter teeth enter and leave the cut. This factor is doubly important with carbides since vibration and chatter are more injurious to carbides than they are to the softer cutting tool materials.

The second advantage of flywheels is that they help maintain a more constant cutting speed through the entire length of cut, carrying the machine through intermittently heavy cuts without stalling the motor or slowing it down below the cutting speed which is desirable with carbides.

As for the size of flywheel, a good rule-of-thumb is to make the fly-wheel bigger than the cutter and also larger than the largest gear on the main spindle. Putting a lot of beef into the cutter body also helps smooth out the cutting action.

The Selection of Grades

Any chart of the nature of the one shown—in which major classifications of milling jobs as they affect grade selection are listed—has a natural tendency towards oversimplification. However, the user cannot go far wrong by starting with the suggested grade—providing other re-

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quirements have been met—then changing to another grade if the job gives indications of requiring greater emphasis on some other carbide "quality."

The Milling of Steel, Cast and Malleable Irons

Steel milling is divided into three classifications based on a shifting of the relative importance in qualities required in the carbide. All carbide qualities given here are relative—as between grades of carbides. For instance, all grades of carbides are more wear and abrasion resistant than are other commonly employed cutting-tool materials. However, simple tungsten carbides are more wear-resistant than are the tungsten-titanium-tantalum carbides; while these "triple" carbides, in general, are tougher than straight tungsten carbides.

Chart for Selecting the Correct Grades of Carbide for Milling Operations

Job	Job Characteristics	Required qualities in carbides	Suggested carbides*
		STEELS	
Rough milling	All	Cratering resistance; toughness; wear resistance; edge strength	Tungsten-titanium-tantalum carbide, Grade 78B
Finish milling	Heavier feeds or cuts	Wear resistance; cratering resistance; toughness; edge strength	Tungsten-titanium-tantalum carbide, Grade No. 78; Harder or 78B tougher
	Lighter feeds or cuts	Same as above; even more abrasion resistance and edge strength	Straight tungsten carbide, Grade No. 883.
		PLAIN CAST AND MALLEABLE IRONS	
Rough and finish milling	Rough castings	Toughness; Wear resistance; Cratering resistance	Straight tungsten carbide, Grade No. 44A.
	Smoother castings; finishing cuts, etc.	Abrasion resistance; toughness; cratering resistance	Straight tungsten carbide, Grade No. 883 (Greater abrasion resistance)
		STEEL TYPES OF CAST AND MALLEABLE IRONS OF IRONS WITH HARD SECTIONS	
Rough and finish milling	All	Cratering resistance; abrasion resistance; toughness	Tungsten-titanium-tantalum Carbide, Grade No. 78 or 78B for those irons most nearly approaching steel in character. Straight tungsten carbide, Grade No. 883 when higher abrasion resistance is required.
		ALUMINUM ALLOYS	
Rough and finish milling	General milling	Abrasion resistance; toughness; wear resistance; ability to take and retain a keen edge	Straight tungsten carbide, Grade No. 883
	Form milling	Same as above. Must also resist formation of a built-up edge	Tungsten-tantalum carbide, predominantly tungsten, Grade No. 907
		MAGNESIUM, ZINC ALLOYS, BRASS, BRONZE, PLASTICS, FIBER, ETC.	
Milling	All	Abrasion resistance; wear resistance; toughness	Straight tungsten carbide, Grade No. 883

* The grade numbers refer to products of the Carboloy Company, Inc.—Editor.

In rough milling steels, where chip load is heavy, maximum cratering resistance (as provided by carbide grades of the 78B type) is usually of primary importance. Toughness, wear resistance, and edge strength under impact loading, in their order of relative importance, are also required characteristics of the carbide suitable for such work.

A straight tungsten carbide is suggested for finish milling if cuts or feeds have to be light, since under such conditions the cutting edge has to resist more abrasion than is encountered where heavier cuts or feeds are possible.

For heavier finishing cuts, the option of two grades are suggested. In general, if the job comes closer to rough milling, a grade equivalent to 78B will be more likely to produce best results.

Cast and malleable irons are divided into two groups since many present-day irons approach steel in machining characteristics. Steel-cutting grades of carbides frequently give better results on malleables than do the straight iron-cutting grades. There is quite a similarity here to the recommendations for finish milling steels.

In this group are included those irons with hard spots or hard sections, inasmuch as such sections frequently control the selection of the carbide by making toughness rather than abrasion resistance the limiting factor as regards tool life.

For milling the simpler cast and malleable irons, abrasion resistance is usually the limiting factor as to tool life. Straight tungsten carbides are usually considered best for this work. Where work sections are particularly rough, the tougher grades of straight tungsten carbides provide somewhat greater life. On smoother castings and for taking finishing cuts, the more abrasion-resistant grades of straight tungsten carbides will usually give longer tool life and a flatter finish.

Non-Ferrous Alloys

For most aluminum milling, straight tungsten carbides usually work out best. These grades provide a high degree of resistance to the abrasion caused by the aluminum oxides and other abrasive materials included in many aluminum alloys.

In some aluminum milling—such as form milling—formation of a built-up edge on the tool may cause trouble. The addition of a slight amount of tantalum to the carbide helps to resist the build-up.

On other non-ferrous metals and non-metallic materials a straight tungsten carbide usually gives best results inasmuch as in most of these materials the most important carbide qualities called for are ability to resist abrasion and wear and ability to take and maintain a keen cutting edge.

Resistance Welding

[An understanding of fundamentals concerning oxyacetylene and electric-arc welding processes can be assumed to be general in railroad shops which have used both methods for many years. Resistance welding is less-commonly used in railroad shops. The following abstract from an article on basic definitions in welding technology prepared by C. H. Jennings, welding engineer, Westinghouse Research Laboratory, Westinghouse Electric & Manufacturing Company, makes clear the distinctions between various applications of the process.—EDITOR.]

Resistance welding covers a group of processes wherein

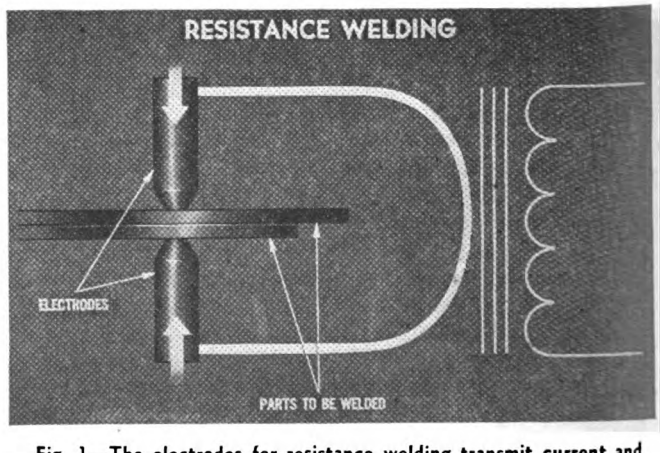


Fig. 1—The electrodes for resistance welding transmit current and apply pressure

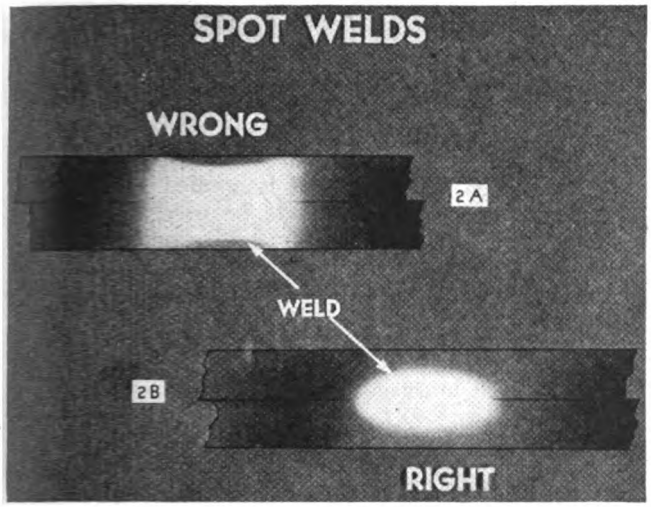


Fig. 2—Fusion of metals in resistance welding should not extend to the surface of the pieces being joined

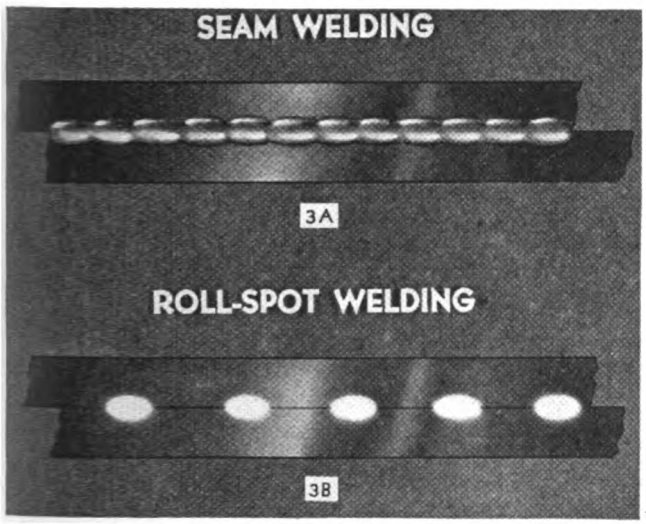


Fig. 3—Timing of current flow between electrodes gives desired weld spacings

the welding heat required to make the weld is produced from the resistance offered by the parts and contact surfaces to the passage of a heavy electric current. Pressure is used in combination with the heating to complete the weld. Types of resistance welding are spot welding, projection welding, seam welding, resistance butt welding and flash welding. Only the spot welding process will be described.

In spot welding, the pieces to be welded (two or more) are clamped between two copper or copper-alloy electrodes, Fig. 1, mounted in a suitable machine capable of applying pressure between the electrodes. These electrodes are used to conduct the welding current and to supply pressure to the parts. Usually they are water cooled to help prevent sticking, burning, and deformation under heat. The weld is made by passing a heavy current through the electrodes and work pieces. This heavy current is obtained by practically short circuiting the secondary of an extremely high-current welding transformer.

The resistance of the metal pieces and their contact surfaces to the heavy current passing through them causes intense heating. This heating, in combination with the applied pressure of the electrodes, produces fusion between the parts resulting in a circular weld known as a spot weld. The size and diameter of the spot weld will depend upon many factors such as type and thickness of parts being welded, diameter and shape of electrodes, amount of pressure, amount of current and welding time. These factors will also affect the size of the fused nugget of the weld. In some cases fusion of the metals may extend to the outer surfaces, Fig. 2(a), while in other cases it may be confined to a narrow volume as shown in Fig. 2(b). In general a controlled nugget of the type shown in Fig. 2(b) is preferred, and on certain materials such as stainless steel and alclad aluminum it is essential if proper corrosion resistance is to be preserved.

Seam welding is a process similar to spot welding and varies in that rollers are used for electrodes. By properly timing the periods of current flow as the parts are passed between the roller electrodes a series of spot welds are made. If the spots overlap a continuous weld is made, Fig. 3(a). If the spots do not overlap and a space is left between welds, Fig. 3(b), the process is known as stitch or roll spot welding.

Projection welding is another variation of spot welding and consists of placing projections on one of the pieces

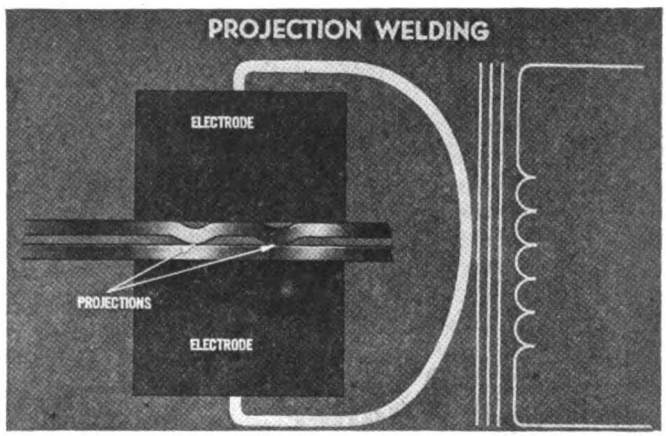


Fig. 4—Projection welding is particularly useful where the thickness of pieces being joined vary greatly

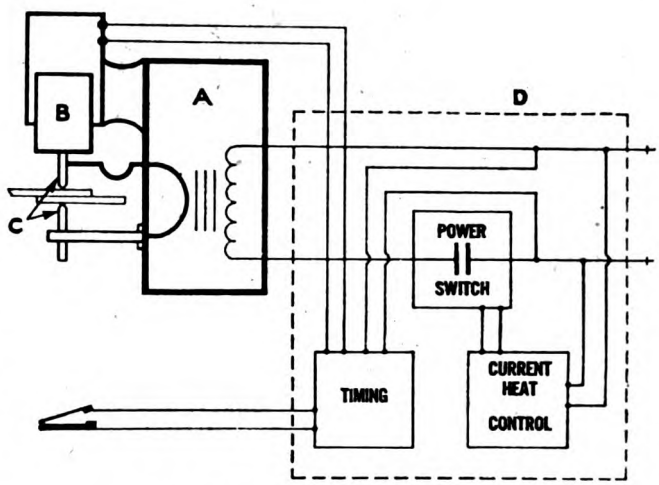


Fig. 5—Elements of a resistance spot welder

A—A heavy frame supporting an extremely high-current transformer.
B—Pressure head for the electrodes.
C—Electrodes, made from copper or copper alloys and usually water-cooled.
D—Controls.

to be welded, Fig. 4, after which current is passed through the work pieces. Large electrodes are generally used in this process and the projection locates the points at which the welds are made. Projection welding is particularly adapted to the production of more than one weld at a time, and to the welding of two pieces varying greatly in thickness.

Resistance welding is a high-speed process and is particularly adapted to production work, especially to the quantity production of small parts. It is applicable for use on a great variety of materials both ferrous and nonferrous, and although it is most commonly applied on parts ¼ in. or less in thickness recent developments have extended the process to the welding of materials ½ in. thick and above.

The increased knowledge of the metallurgy of resistance welding combined with modern resistance-welding machines and control has vastly increased the application of this process. The principal elements of a modern resistance spot welder are shown in Fig. 5.

The problems of resistance-welding control may be divided broadly into three parts: start-and-stop control of the current to the welder, control of the amount of current that flows, and control of the welding time and electrode pressure sequence.

All three of these basic control problems are handled electronically which has resulted in giving resistance welding speed and exactitude and extended its application to practically every metal fabricating industry, both for subassembling and for final assemblies. So precise is the control by electronics that even materials such as aluminum, stainless steel, alloy steel, and magnesium, which was once considered non-weldable, are now welded on a mass-production basis. It is possible to weld two ⅛-in. strips of stainless steel by shooting through them a current of approximately 15,000 amperes for a fifth of a second. Alloy steels can be welded, grain-refined, and tempered without removing the electrodes from the work.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Welding Side-Sheet Patches

Q.—When applying firebox side-sheet patches, what type of weld is used? How are the patches secured in place for the welding operations?—M. F. K.

A.—The butt weld with a vee joint is generally considered as best for welding on firebox side-sheet patches. The edges of both the old and new sheets must be clean and beveled. The angle of bevel varies somewhat on various roads but the generally accepted practice is to use a 30-deg. angle on each sheet giving a 60-deg. included angle at the joint. The patch should be bolted so that a gap of 1/16 in. is left all around. This can be done by setting staybolts in every other staybolt hole around the perimeter of the patch, the staybolts acting as spacers so that the patch will lay flush with the side sheet. Common bolts are then applied in the remaining holes to hold the patch in place for welding. Straps can also be used, the straps being bolted both to the side sheet and the patch. The seam is tack welded at intervals of about 12 in. so that the patch cannot get out of line. The bolts or straps are then removed. The first bead, or pressure bead, is made with ⅛-in. diameter welding rods to insure penetration as the weld on the water side must be clean and flush with the sheets and have no gaps or mud catchers. The first bead is laid directly in the center of the seam. No attempt should be made to fill the gap with the first bead. After the first bead is applied, 5/32-in. and 3/16-in. diameter electrodes should be used to complete the weld, each layer of weld metal being thoroughly cleaned of all scale.

Syphons Complete With Crown Sheet

Q.—Is is possible to obtain thermic syphons complete with the crown sheet?—R. E. F.

A.—Syphons are furnished with flanges of sufficient width and length so that when the syphons are applied they form the entire crown sheet. The front of the syphon flange is welded to the firebox tube sheet and the rear of the flange to the firebox door sheet. The firebox sides are extended up to the flange of the outside syphon and the longitudinal edges of the syphons are butt welded together to form the crown sheet.

Gas Flow In Front Ends

Q.—Our Mikado-type locomotives are equipped with the Master Mechanic's front end. Would the elimination of the Master Mechanic's front end increase the flow of the gases to any appreciable extent?—M. E. F.

A.—The University of Illinois front-end tests showed that for a given steam rate and the velocity of discharge, i.e., with a given nozzle and pressure, a decrease in the resistance to the passage of gases resulted in a larger amount of air being moved with a reduced draft, and vice versa. The elimination of the Master Mechanic's front end from the smokebox improved the rate of gas flow a maximum of eight per cent over the performance of the same smokebox with it installed. In actual practice this improved rate of gas flow cannot be obtained as some form of front-end arrangement is required to present live cinders from going out of the stack.

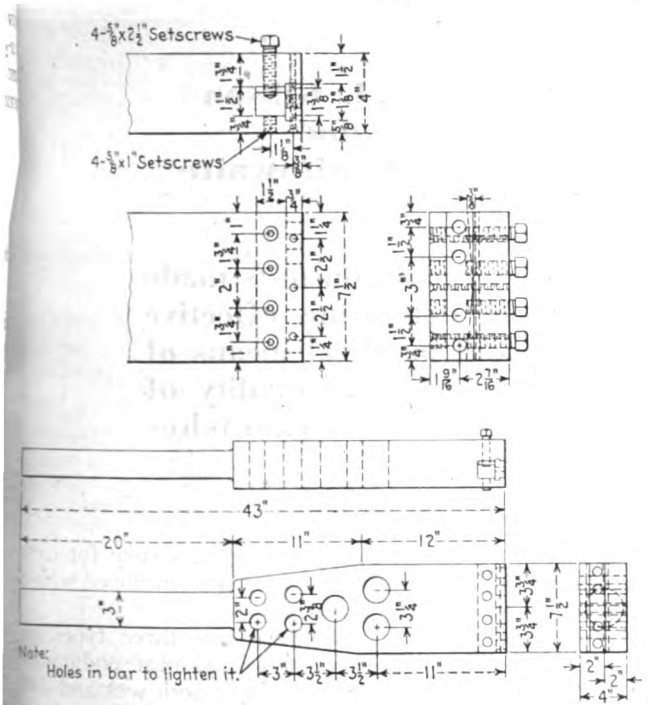
Tool Holders for Machining Locomotive Parts

Among the numerous shop-developed devices in use at the Finley shops of the Southern located in Birmingham, Ala., are tool holders designed especially for machining operations on locomotive parts. The two shown in the drawings and photographs are among the most useful. One of them, the double bar used on a slotter for machining the toes on crown brasses, is in almost constant use because of the volume of driving-box work in the shop; the other, used for truing and finishing eccentric crank arm pins, is mounted on the spindle of a standard drill press as work requirements dictate.

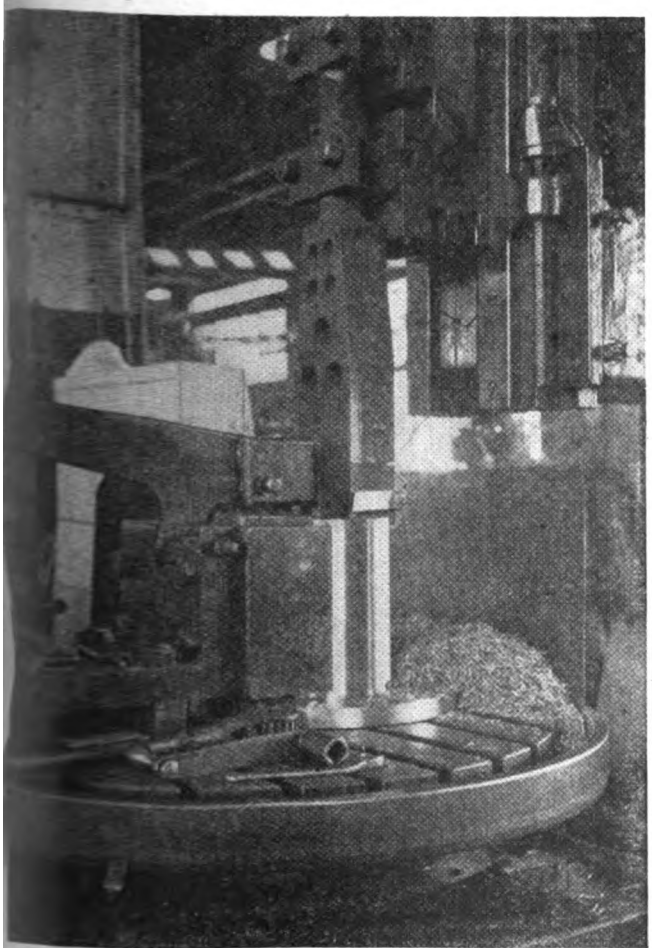
Crown brasses are held in position on the work table of the slotter by an air clamp which is of rugged construction and in which the brasses are mounted on end. The tool holder is designed so that both toes of a brass are machined with each stroke and, when the machining operation is complete, the toes have been finished with the correct radii and tapers by specially-ground tools.

The offset tool holder for finishing crank-arm pins fits over the end of the spindle on a standard drilling machine

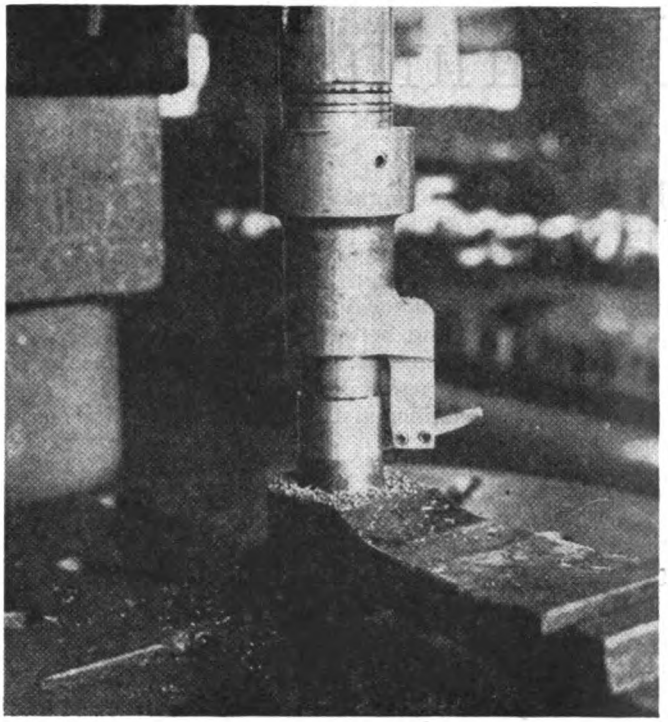
and is fastened in place by three set screws. The offset arm holds the tool. Work pieces are clamped in the usual manner to the table and finished using the highest possible spindle speeds consistent with the depth of cut being



Tool holder for a slotter which holds cutters to finish both toes of crown brasses in one operation

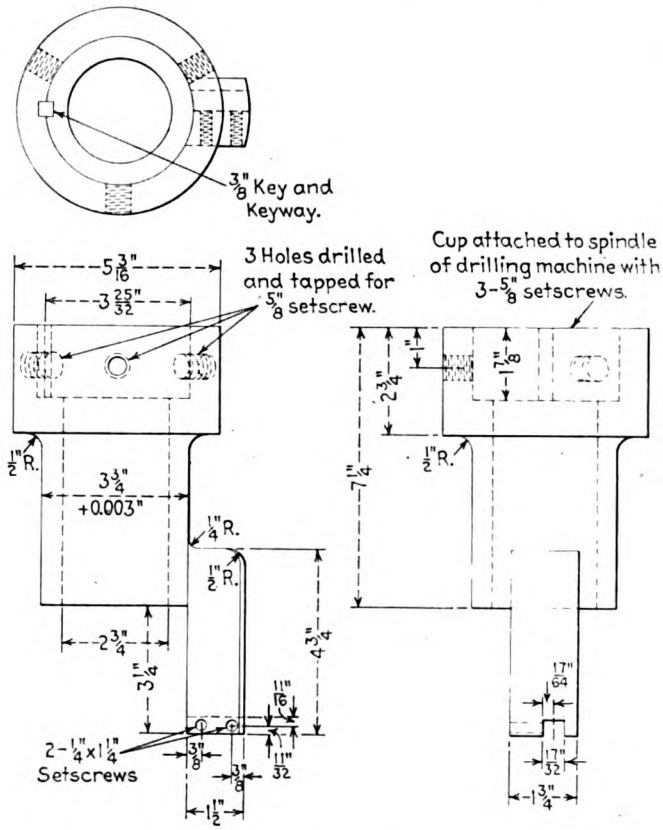


Both toes of crown brasses are machined at once by the use of this double bar on a slotter



The offset head on this tool holder permits using a drill press to finish crank-arm pins

made. According to shop supervisors this tool is especially useful because of the speed with which it can be applied to a drill press when it is needed and because, being used on this machine tool, less delay is encountered than would be met in doing this work on any of the other shop machines adaptable for the purpose but less likely to be available at any given time than a drill press.



Drawing of offset tool holder for machining crank-arm pins on a drill press

Insuring Varnish Quality

By D. L. Gibson*
and
C. H. Braithwaite*

A report on tests made to determine effective and practical means of maintaining quality of insulating varnishes

EACH filtration of contaminated insulating varnishes saves 25 cents to $2.50 a gallon in material and labor costs and increases dry dielectric strength about 30 per cent; wet dielectric strength about 200 per cent. Such filtering can be satisfactorily accomplished with portable equipment. The time between filtering operations depends upon use in the tank and care taken in operation.

There are three mechanisms of contamination of the varnish. The contaminant may be washed from a piece

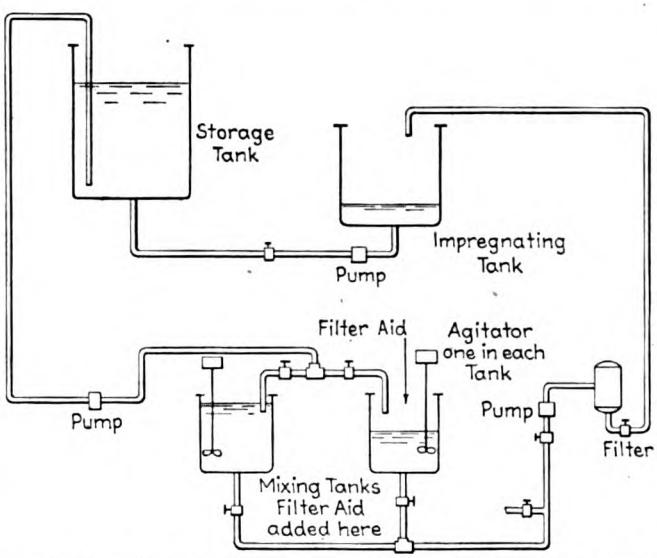


Fig. 1—Flow diagram for the reclamation of insulating varnishes through pressure filtration

of apparatus while it is immersed in the varnish tank. This means the suspension of particles of a particularly troublesome nature in the varnish. For example, when rehabilitated armatures are being processed, some of the dust and dirt accumulated in service is washed into the varnish tanks when the apparatus is immersed. Carbonaceous dust, metal chips of small diameter, small droplets of paint and other foreign material may enter the varnish when the tank lid is open.

Finally, material foreign to the varnish may be added by mistake. The addition of a varnish whose resin is only slightly soluble in the varnish and its solvent in the tank is an example. Here the foreign resin would be precipitated out, possibly as troublesome colloidal particles.

Contaminants may be generally classified as conducting and non-conducting. Carbonaceous dust, metal particles and electrolytes are conductors. Non-conducting particles are represented by wood chips, and precipitated or polymerized resins, pieces of cotton, asbestos and mica dust. This material comes from pieces of insulation washed off the coils and wound apparatus on immersion in the varnish bath.

These contaminants periodically require rehabilitation or disposal of large quantities of varnish. To prolong its use and avoid its disposal, and to conserve critical materials and maintain the high insulating values needed, a satisfactory method of cleaning the varnish has been developed. Portable pressure filters have proved adequate for this operation. In addition, a system for control and test of these varnishes has been developed which indicates when filtering is needed.

Contamination may be classified into three types by use of wet and dry dielectric tests and heat endurance tests. Conducting particles may lower both wet and dry dielectric strength, and very probably impair the heat endurance of the varnish. A second type is identified by a high dry dielectric strength, a low wet dielectric

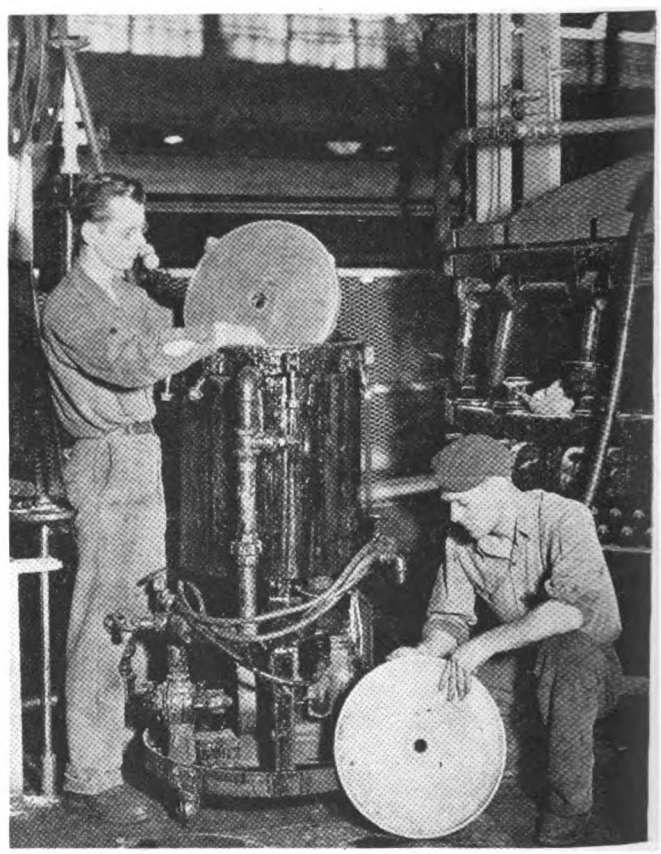


Fig. 2—Cleaning the stainless steel filter plates of a portable pressure filter—Extreme care must be exercised to keep every one of the 1/16-in. holes open—For filtering, pressures of 15 to 28 lb. per sq. in. are used, with rates of flow varying from one to five gallons per minute, depending upon the pressure, amount of cake and viscosity of filtrate

* Insulating development engineers, Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa.

strength, and a low heat endurance. Contamination producing varnish gels or precipitated resins might not lower the dielectric strength but might lower the heat endurance or life of the varnish film.

Disruption of the varnish film by particles of foreign matter seriously impairs the properties of the insulation. On electrical equipment there is no need to mention the

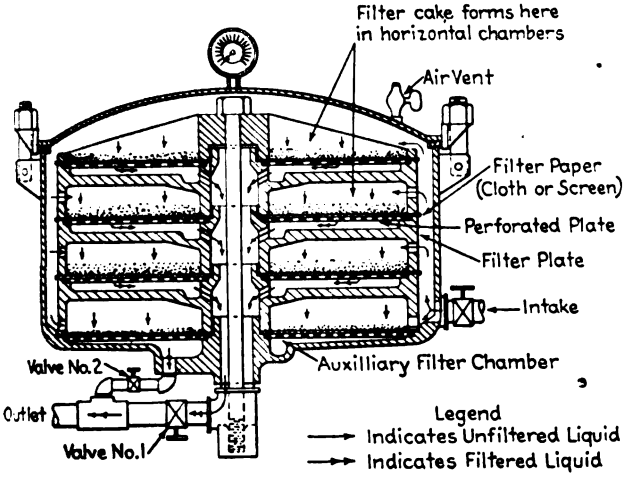


Fig. 3—Cross-sectional view of horizontal plate, pressure type filter

effect of electrically conducting or ionizing particles on the dielectric breakdown value, particularly when they become inbedded in the insulation. In some cases, although the particles are not conducting, they cut into the insulation during processing, lowering the breakdown level of the material.

Thus, it is important to keep varnish for treating electrical equipment as clean and as free from foreign material as possible. As a base or goal, the electrical properties and mechanical properties should be kept in the same order of magnitude as those of the new varnish.

Careful control of the varnish requires an adequate filtration method. The materials used in varnish manufacture are critical and maintenance of the varnish in usable condition is essential. The particle sizes of contaminants range from large pieces of wood to colloidal carbon. Pieces of metal as small as .003-in. in diameter have been found. A study of the available methods indicates that the most efficient method of reclamation of the varnish and conservation of critical materials is by pressure filtration.

Pressure Filtration

A portable type pressure filter, consisting of a number of plates arranged vertically and enclosed in a shell, was found to be satisfactory. Pressures of 15 to 28 lb. per sq. in. are used with rates of flow varying from one to five gallons per minute depending upon the pressure, amount of cake and viscosity of filtrate.

Filtration was carried out, using a diatomaceous earth as a filter aid. This was found to be particularly necessary since some of the contaminating material filtered out was a gel, and quickly filled up the pores of the filter medium. The addition of filter aid allowed a porous cake to build up which was not as easily clogged as the filter medium alone. In order to avoid addition of the filter aid to the large varnish tanks, two 100 gallon tanks were set up in which the diatomaceous earth was continuously mixed with the incoming varnish stream. Varnish was pumped from here through the filters and into a clean tank in the system.

In addition, strainers which eliminate particles greater than 20 mils in diameter have been installed in the tank system. The particles which are particularly troublesome are, in general, below 20 mils in diameter.

Filtering of varnishes in tanks in shop use presents more problems than filtering of new varnish. New varnish will not have the detrimental foreign material such as metal chips, white lead, carbon dust, that varnish in shop use will accumulate. However, new varnish may need to be clarified by use of filter-aid and pressure filtering, centrifuging or settling, or some combination of these methods. The advantage of filtering newly made varnish is that it may be handled while hot, with resulting low viscosity. Frictional losses are much less at lower viscosities, so that a greater "through put" results. The flow rate is in inverse proportion to the viscosity.

Varnish in use in repair shops obviously cannot be heated because of fire hazard and heat causes rapid polymerization, with a resulting short tank life. Filtering must be done at room temperatures, usually 20-35 deg. C., with consequently higher viscosities. The viscosity will vary with the type of varnish and condition of the varnish in the tank. A rise of temperature in a varnish tank from 25 to 35 deg. C. will lower the viscosity approximately 50 per cent, so it is important to filter at 25 deg. C. or higher, if possible. In addition, it is possible to handle different types of varnish in a portable shop filter. When changing from one varnish tank to another, careful cleaning of the filter is required.

Effects of Filtering

The efficiency of the filtering treatment is judged by a series of chemical and physical tests on samples taken before and after filtration. Viscosity at 25 deg. C. per cent of solids, and specific gravities at 25 deg. C. are checked. Significant results are obtained from dielectric tests and a heat endurance or life determination test made on a varnish film. Heat endurance is determined by depositing varnish films of .002-in. thickness on copper strips. These are continuously heated at 150 deg. C. and the time noted to produce failure of the film on bending about a ⅛-in. mandrel. Dielectric tests consist of measuring the dielectric breakdown strength

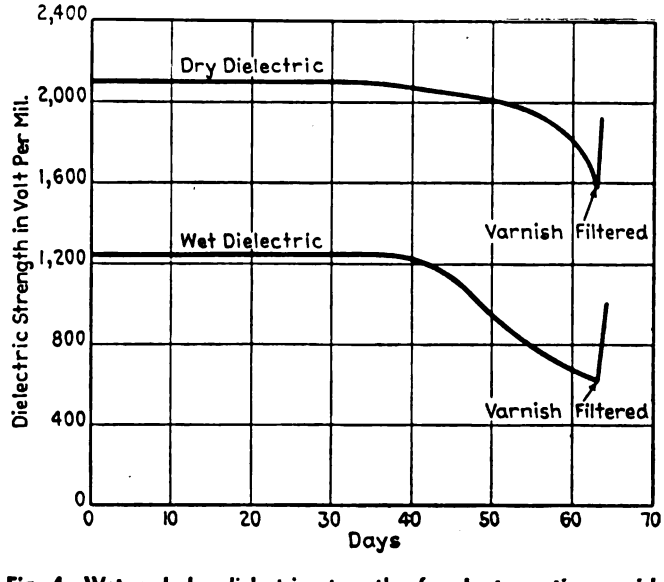


Fig. 4—Wet and dry dielectric strength of a heat reactive varnish "before" and "after" pressure filtering—The dielectric strength remains fairly constant for 40 days, then it starts declining—At the end of 60 days it has reached a point about one-half normal value—After filtering it has returned to its normal value

of a .002-in. thick varnish film on each side of a 5 mil copper sheet, both as received and after immersion in water for 24 hours.

Filtering of shop varnish tanks has given information on the behaviors of various varnishes under continuous use. Information has been obtained on varnish filtered through portable pressure filters in lots of 100 to 2,000 gallons. Varnishes varying from asphalt gums dissolved in naphtha-type solvents to synthetic resins in toluene were filtered. Each varnish presents a different problem as to "through-put" and rate of flow to produce desired clarity and removal of contaminants. Samples of the varnish were taken before, during and after the filtering operation. Percentage of body, viscosity, and specific gravity show whether or not there is a loss of solvent or varnish resin during the filtering operation. The results of the heat endurance tests and dielectric tests before and after the operation show whether or not harmful foreign materials were present and if they have been removed.

Table I—Filtration of Heat Reactive Varnish

	Before filtering	After filtering
Viscosity (secs.) at 25 deg. C.	162	157
Body, per cent	53.59	53.57
Specific gr. at 25 deg. C.	0.977	0.977
Heat endurance at 150 deg. C. in hrs.	46	64
Wet dielectric, v.p.m.	623	1,100
Dry dielectric, v.p.m.	1,597	1,914

Note: This tank is used for treating wound apparatus and repaired armatures.

Table II—Filtration of Heat Reactive Varnish

	Before filtering	After filtering
Viscosity (Secs.), at 25 deg. C.	338	310
Body, per cent	59	59.08
Specific gravity, at 25 deg. C.	0.997	0.995
Wet dielectric, v.p.m.	935	1,050
Dry dielectric, v.p.m.	1,610	2,200

Note: This tank is used for impregnating coils.

Table III—Filtration of Asphalt Base Varnish

	Before filtering	After filtering
Heat endurance at 150 deg. C., in hrs.	22	31
Dry dielectric, v.p.m.	791	946
Wet dielectric, v.p.m.	1,591	1,665

Note: This tank is used for dip coating coils.

Typical results of filtering different kinds of varnish are shown in the accompanying tables.

Improvements in dielectric properties produced by filtering the varnish are remarkable. An average increase in dry dielectric strength in the order of 30 per cent and in the wet dielectric strength in the order of 200 to 250 per cent were found. Heat endurance and the mechanical properties of the varnish improved from 10 to 20 per cent upon filtering. In one case a badly contaminated sample was filtered with an improvement in heat endurance of over 100 per cent being noted.

Plastic asphalt varnish improved in this characteristic over 40 per cent after filtering. An increase in heat endurance indicates particles of colloidal matter which damage the varnish film have been removed. The improvements cited are examples of varnish in poor enough condition to show the harmful effects of extreme contamination. Varnish tanks should not be allowed to fall to such a poor level under ordinary conditions. It should be realized, however, that the varnish characteristics of tank varnish can be restored to the approximate level of new varnish, but cannot be improved significantly over that level.

For example, in Table I the wet dielectric strength of the varnish film was increased after progressive filtering until a dielectric breakdown of about 1,100 volts per mil was obtained. This is essentially the same as new varnish. Reference to the curves, Figs. 4 and 5, shows bi-weekly checks on the dielectric strength and heat endurance of varnish from the same 2,000-gallon tank for a period of 60 days. After 40 days, the wet and dry dielectric strength started to decrease and the wet dielectric strength reached a point about one-half of the normal value in 60 days. After filtering, the dry dielectric breakdown returned to its normal value of about 2,000 volts per mil. It is interesting to note the effect of the addition of a varnish incompatible with the varnish in the tank. Less than three per cent of such a varnish was added to a sample from this 2,000-gallon tank twenty days before filtering. The adverse effect on heat endurance, Fig. 5, is easily discernible.

This condition was not corrected entirely by filtering, as can be seen by reference to Fig. 5. This is an example of a fine colloidal material that cannot be readily removed by filtering.

In all tanks cited there was no change in percentage body, viscosity, and specific gravity during filtering. This indicates no change in varnish composition. Serious objection has been raised in the past to filtering varnishes of this type, due to loss in body or resin. Using the closed type of pressure filter, the only loss noted was solvent, which could be replaced easily.

From compilation and correlation of these data with manufacturing experience, it has been found that frequent filtering of insulating varnishes is necessary during shop use to maintain the high insulating level of the varnish film and to prevent possible mechanical damage of insulation by foreign particles. Portable pressure filters proved satisfactory for this operation. It is apparent that the type of contaminant depends upon the material treated in the tank. The length of time between filtering operations depends upon the use or activity in the tank and the care taken in operation of the tank. Insulation varnishes are complex chemical mixtures, and care should be maintained in their use. The use and maintenance of varnishes are chemical engineering operations; therefore it is important that they be under the control and supervision of persons with the proper training and experience. Filtration of electrical insulating varnish is a step forward in the conservation of those critical materials used in its manufacture.

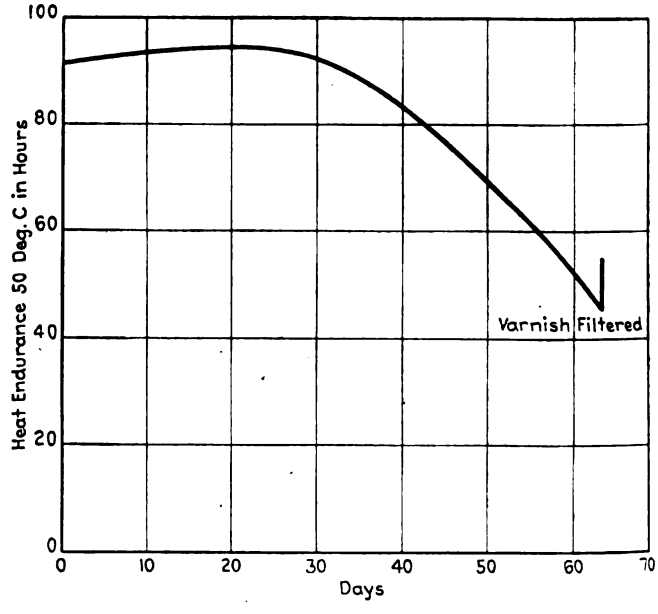


Fig. 5—Heat endurance of a heat reactive varnish "before" and "after" pressure filtering—The adverse effect on heat endurance is easily discernible—Filtering did not entirely correct as there remained a fine colloidal material not readily removed by filtering

Radio Channels Accepted

F. C. C. proposals receive approval of railroads with requests for minor changes only

On January 16, 1945, the Federal Communications Commission issued a report bearing the title, "In the Matter of Allocation of Frequencies to the Various Classes of Non-Governmental Services in the Radio Spectrum from 10 Kilocycles to 30,000,000 Kilocycles," (Docket No. 6651). This report proposed that the railroads be assigned 33 clear channels in the 156 to 162 megacycle band and that they share certain other channels in the television and other bands.

At a hearing held in Washington, D. C., on February 28-March 2, 1945, all interested parties were given the opportunity to voice their opinion of the Commission's proposals. The railroads' reply was offered in a joint brief prepared by the Association of American Railroads and Committee 7, Railroads' Radio Communications Services, Panel 13, Radio Technical Planning Board.

The commissioners assigned to the hearing were Paul A. Porter, chairman, E. K. Jett, Paul A. Walker, Norman S. Case, C. J. Durr, and Ray C. Wakefield, five members sitting through all of the proceedings. The railroads' joint brief was presented by William J. Milroy, attorney, Atchison, Topeka & Santa Fe, acting as counsel, Association of American Railroads.

The following is the joint brief:

Railroads' Reply to Commission's Proposals

1. In its proposed allocation of frequencies to the railroads, dated January 15, 1945, the Commission states: "As in the case of other services in this portion of the spectrum, an average channel width of 60 kc. is assumed. It is further assumed that adjacent channels will not be used in the same area." We do not fully understand the Commission's statement in respect to 60 kc. being assumed for other services in this portion of the spectrum when we note on page 47 of the Report 200 kc. bands are allowed for aviation services as low as 118-132 mc. The aviation service in our opinion is not subject to any operating conditions more severe than the railroads insofar as frequency stability factors are concerned.

As pointed out in our testimony at the hearings, Dockets 6593 and 6651, we do not believe that it is practicable at the present state of the art to work within such a narrow channel at frequencies of 156 to 162 megacycles. Panel 13, Steering Committee, at the time of the hearing, Docket 6651, recommended allocations on the basis of 60 kc. channel widths. At the meeting of Committee 7 in Chicago on December 12 and 13, 1944, we again considered the channel width problem and in discussing the matter with Professor Noble, chairman of Panel 13, were advised that 100 kc. instead of 60 kc. were presently recommended by the Steering Committee for frequencies above 132 mc. and that the R. M. A. Emergency Service Equipment Committee favored 120 kc. Obviously, if the majority of the Steering Committee of Panel 13 who had previously recommended 60 kc. could change its views so quickly something was radically wrong with its first views.

60-kc. Width Impracticable

In order to determine if the manufacturers could presently supply us with equipment that would operate on 60 kc. channel width we wired the RCA, General Electric, Westinghouse Electric & Mfg. Company and Bendix Radio, as follows: "Radio service being established for railroads between 156 and 162 megacycles with 60 kc. band width. Please wire us promptly at Indianapolis if your company is in a position to presently furnish radio equipment that will operate on 60 kc. band width under railroad conditions." Their replies are attached, and you will note they are unanimous in their view that 60-kc. channel width is presently impracticable.

We also do not believe it will be practicable to work adjacent channels even at 100 kc., which view is confirmed by both Bendix and General Electric in their replies mentioned above.

In effect, therefore, the 33 channels allocated with 60 kc. channel width or a total of 1,980 kc. band will provide 19.8 channels of 100 kc. and assigning them alternately afford only 10 clear channels. If actual experience indicates that additional space is required we will rely on the Commission's assigning us such space in the unassigned portions of the 156- to 162-mc. band and in the 102- to 108-mc. band as mentioned in the report.

2. Considering now the channels assigned for yard and terminal operation, while we do not note that channel widths in these services are mentioned, we assume the Commission had in mind 60 kc. for the 192-216 mc. band and in such event the previous statements in connection with the end-to-end service will apply insofar as channel widths are concerned. For the bands 44-50 mc. we assume 40-kc. channels will be allocated and for 54-78 mc., 50-kc. channels.

Television Bands

As far as we know, no one at present is in a position to say whether it will be practicable to operate in interspersed television bands. At the meeting of Panel 2 in Washington, D. C., November 1, 1944, it was observed that none of the experts present committed themselves to an outright statement that such a plan was feasible. Attention is called to a statement of Professor D. E. Noble, chairman, Panel 13, to the Commission on the report of Panel 2, wherein he states: "I am extremely pessimistic about the success of the proposed share-the-channels Television-Mobile Communication plan."

Also, we call attention to a memorandum prepared by Mr. David B. Smith, chairman, Panel 6, Television, R. T. P. B., dated October 30, 1944, on the Joint Use of Channels by Television and Communication Services. In this memorandum, under the title, "Adjacent Channel Interference," Mr. Smith states: "Again neglecting tropospheric effects, adjacent channel television stations can be reassigned at about 85 miles with the limitation that between the 5.0 mv/m and the 0.5 mv/m contour, the television user will probably receive only one of the two

stations. The communication service can operate on the adjacent television channel but only in the vicinity of the television station, otherwise the communication service will interfere with television service. The size of this communication area will depend upon the relative power of the television service and not of the communication service. The higher the ratio of television power to communication power, the further the communication power can be from the television station. In any case it appears that the communication area will be local in area and its transmitter cannot be very far from the television transmitter."

Note particularly that it is Mr. Smith's opinion that the interspersed communication can operate on an adjacent television channel only in the vicinity of the television station; otherwise, it will interfere with the television service and by the same criterion we can well imagine the interference that will result to the communication service from the television station.

Again, at a joint meeting of Panel 2 and Panel 13 in New York on December 20, 1944, it was observed that serious doubt existed in the minds of many present as to the practicability of the proposed sharing and a subcommittee of Panel 2 submitted the following report:

"1. The subcommittee of Panel 2 is unable to develop a plan of shared channel operation between communication services and television broadcasting services. This is not to say that such a plan might not be accomplished but more data and experience will be required than are now available. One difficulty has been the lack of jurisdiction of the Committee to make any determination of channel allotments to the several services on the basis of public interest, convenience and necessity.

"2. Therefore, the subcommittee recommends that allocations be made to the services on the basis of exclusive assignments as between television and communication services. This is not to exclude geographical channel sharing between the several classes of communication service."

Taking the above into account we are very much concerned as to the practicability of the proposed allocation by the Commission, especially since about two-thirds of the total frequencies allocated to us are on an interspersed basis. We recommend, therefore, that the Commission allocate cleared channels for these services in the unassigned portions of the 156- to 162-mc. band and in the 102- to 108-mc. band, as mentioned in the report.

3. No mention was made in the Commission's report of our desire to use end-to-end, yard, terminal and point-to-train frequencies interchangeably as brought out in our Report M-1940 and in our Report M-2019 to which was attached M-2020-2.

A number of railroads, due to pooling of power and for flexibility in operation, desire to use the frequencies assigned them interchangeably and since any interference that would result will be internal to the railroad concerned we assume the Commission would have no objection and we would recommend that the usage be confirmed by formal action.

4. We also note that no mention was made in the Commission's report of our desire to use such frequencies as may be assigned for end-to-end, yard and terminal operation, in harbor craft service or tug boat dispatching, as stated in our Preliminary Report No. 4, M-2019. It is assumed that the Commission will have no objection to the railroads utilizing these frequencies for this purpose and we would recommend that the usage be confirmed by formal action.

The report is signed by William J. Milroy, counsel, Association of American Railroads and John L. Niesse, chairman, Committee 7, Panel 13, R. T. P. B., and representing the Association of American Railroads.

Oral Testimony

Oral testimony was presented by John L. Niesse as follows:

"Although the railroads are pleased with the number of channels proposed for them, there are two important factors which we feel will very seriously reduce the number of these channels to a much smaller amount than stated in the report.

"The first of these important points is the narrow channel width assumed. In its report, the Commission recognized the need for and allocated to us 33 channels for end-to-end and point-to-train service, but the allocations have been proposed on an assumption of a 60-kc. channel width. As we previously advised the Commission, we do not believe it is practicable in the present state of the art to operate on such a narrow channel width at frequencies of 156 to 162 mc. In order to definitely determine the practicability of obtaining equipment that would operate on a 60-kc. channel width under railroad conditions, we asked the RCA, General Electric, Westinghouse Electric & Mfg. Company and Bendix Radio if they could supply such equipment. They were unanimous in their view that it would be impracticable. Therefore we believe, as do the manufacturers, that the minimum channel width should be 100 kc.

"We appreciate the fact that it is possible under certain ideal conditions to build a set that will operate on a 60-kc. channel width but we do not believe it practicable to do so in a mobile set for use in railroad service.

"In requesting 100-kc. channel widths, we feel that we are not unreasonable when it is observed that the Commission has allocated 200-kc. channel widths to the aviation service for frequencies as low as 118 to 132 mc. The aviation service in our opinion is not subject to operating conditions that are more severe than those encountered on the railroads insofar as frequency stability factors are concerned.

Further Recommendation

"I should also like to point out that testing in the 156 to 162 mc. band has been with amplitude modulated equipment. We have not as yet been able to determine whether eventually AM or FM operation will be the more advantageous. Should it finally be determined that FM operation presents outstanding benefits, then we would require a channel width of 150 kc. instead of 100 kc.

"Even at a 100-kc. channel width it will not be possible to operate on adjacent channels in the same area. This view is confirmed by both General Electric and Bendix Radio. The matter of operating on adjacent channels can be best illustrated by reference to the Chicago terminal area upon which the 33 channels are based. The commission has proposed 33 channels, 60-kc. wide, but it assumes that adjacent channels will not be used in the same area. On this basis, therefore, we will have only 16 channels. If these 16 channels are only 60-kc. wide and our equipment requires 100 kc., the result will be that the number of channels will be reduced to about 10 interference-free channels.

"So that our use of radio may not be restricted, we recommend that the Commission assign us sufficient space, preferably in the unassigned portions of the 156-162 megacycle band or in the 102-108 megacycle band, to provide a total of 33 channels 100-kc. wide for end-to-end and point-to-train service. Only by so doing will

the railroads have available the number of channels recognized by the Commission as necessary.

"The other point I wish to stress is that all the frequencies proposed for yard and terminal service are to be shared with television. We are very much concerned about this sharing plan. As far as we know there is no test data available to indicate that such an arrangement is feasible, nor do we know of any experts who will say definitely that such an arrangement will work. In fact, Mr. David B. Smith, chairman, Panel 6, Television, has said in a memorandum on this subject that the communication area of a railroad set operating under this shared plan will be local and the railroad transmitter cannot be very far from the television transmitters.

"Again, at a joint meeting of Panel 2 and Panel 13, a subcommittee of Panel 2 recommended that allocations be made to the services of the two panels on the basis of exclusive assignments as between television and communication services. In our brief we recommended interference-free channels for yard and terminal service and while we would very much like to see interference-free channels made available for yard and terminal operation, particularly for the number of railroads who have indicated they will use radio if frequencies are allocated, we fully appreciate the large demand for frequencies in this particular portion of the spectrum. Consequently, we intend to go ahead on the shared plan proposed by the Commission. If interference develops we will rely on the Commission to make available to us an adequate number of channels as found by the Commission in its report to be reasonably required.

"One final point: For flexibility in train operation, we desire to use the frequencies assigned for end-to-end, point-to-train, yard and terminal, interchangeably, and also to use these frequencies for tug boat dispatching. Since any possible interference that might result would be internal to the individual railroad concerned, we presume the Commission will have no objection to this. However, since the question has been raised by a number of railroads, we recommend that this interchangeable usage be confirmed in the Commission's final report."

Corrosion of Underground Pipe Lines*

Recognition of the facts that no iron or steel pipe which is economically available can be expected to last long in some soils and that protective coatings usually only delay corrosion, has emphasized the importance of other methods of protecting pipe. The most promising of these is electrical. If electrical connections are so made that current flows to the pipe line, the pipe will be protected from corrosion. This is done in many installations by supplying energy from a power plant. Considerable use is also made of zinc anodes electrically connected to the pipe lines. In 1941 the National Bureau of Standards began a series of field tests to determine the conditions under which this method of protection may be effective. (Technical News Bulletin 296, December, 1941.) Experimental combinations of zinc and steel were buried at eight test sites, so arranged as to give different ratios of area of zinc to that of the steel. During the last month some of the specimens from a site near Shreveport, La., were returned to the Bureau. These show that a sample of steel not connected to the zinc lost from 40 to 50 times as much metal as similar samples connected to zinc anodes. These observations are, of course, preliminary and further measurements will be necessary in order to determine the best methods of using the zinc. Moreover, it may be found possible to replace the zinc by aluminum or magnesium, thus providing a use for these metals of which large quantities are likely to be available. Arrangements are being made to bury test sets of these metals during the coming spring.

* Notes from the National Bureau of Standards as prepared by the director for the Journal of the Franklin Institute.

Loudspeaker For Wrecking Operations

To promote efficiency and safety, the Central Railroad of New Jersey has installed a public address system on a service train which amplifies and directs the wreckmaster's voice to the work location and also to the crane operator. The installation was made as an experiment in overcoming the difficulty of indicating crane movements by a code of whistle signals.

The wreckmaster talks into a microphone on the end of a 150-ft. cord and his voice is amplified by a horn-type loud speaker mounted on the boom of the crane. A second smaller speaker in the cab transmits his voice to the crane operator.

The equipment used consists of a 20-watt amplifier at the base of the boom, a University PH horn equipped with a 15-watt S. A. H. driving unit on the boom and a Utah TW8 speaker in the cab. The crane operator also may speak into the address system by means of a push-to-talk microphone located in the cab. Depression of the button cuts the microphone into service and cuts out the speaker in the cab. Power for operation of the system is supplied by a 32-volt d.c. turbo-generator set. An inverter operating from this set supplies 110-volt 60-cycle current to the amplifier.

Wire for Fishing Conduit Runs

By Thomas Trail

In pulling electric wires through conduits, flat steel tapes are generally used. But where the run between pull boxes is comparatively short, it is often easier to use a length of fairly stiff spring wire, such as music wire. This is especially convenient where there are a number of bends in the conduit because the slender wire will slide through the conduit easier since it can bend in any direction, whereas the tape can not easily bend edgewise around sharp corners.

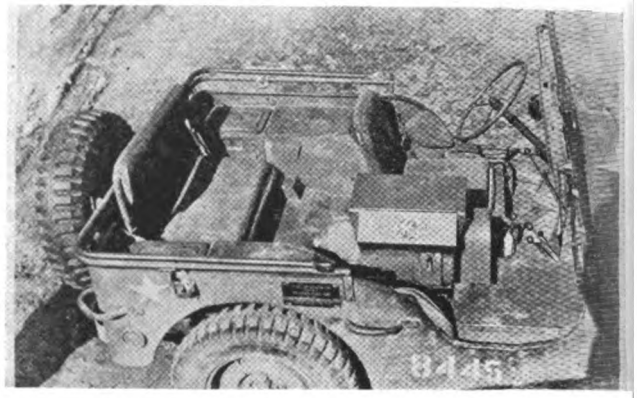
Front and side views of loop used for conduit fishing wire

To enable the spring wire to negotiate the conduit turns even more easily, the type end loop shown should be bent in the wire. This loop will travel with equal ease in all directions.

Jeep-Mounted Welders

Modified G-E arc welders mounted on standard quarter-ton army jeeps are being used extensively by maintenance organizations dispatching contact parties in the combat areas. Because of their compactness and light weight, as well as their maneuverability over difficult terrain, these mobile units have also been adopted for jungle operations and are expected to be used for airborne and amphibious operations. It takes little imagination to conceive of the many ways in which equipment of this kind might be used in railroad service.

Driven by a V-belt on a power take-off from the jeep's engine, the welder is bolted to the floor of the jeep in place of the right-hand front seat. It provides 40 to 250 amp. and is capable of handling electrodes of various sizes up to and including ¼ in. The welder is ready for use as soon as the jeep is stopped. A governor, which is disengaged by a hand-operated clutch for normal operation of the vehicle, maintains the engine speed during the welding operation, while belt guards and heavy protective covers safeguard the personnel. When not in use the welder does not interfere with the customary use of the jeep, since the closed cover serves as a seat.



A 200-amp. 30-volt welding generator mounted in a ¼-ton Army jeep

CONSULTING DEPARTMENT

Motor Mounts For Machine Tools

Can you answer the following question? Answers should be addressed: Electrical Editor, Railway Mechanical Engineer, 30 Church Street, New York 7.

Why are apparently similar sets of transformers sometimes installed in vaults and sometimes on poles or pole platforms? What factors govern the choice of installation?

●

We are using a line shaft driven by a 15-hp. three-phase motor to run several machines in our machine shop. As soon as conditions permit, we intend to install individual motors. Would it be cheaper to build the necessary harness ourselves or buy it already built?

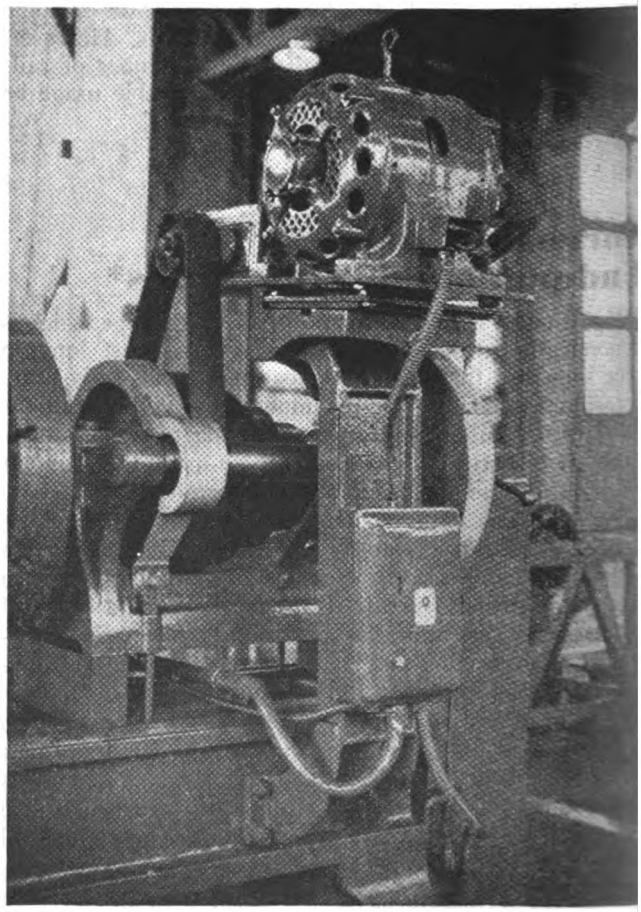
The Answer Is Usually In A Catalog

It is a comparatively simple job to motorize some shop machines and quite complicated for others. Some power-driven hacksaws, for example, offer quite a problem when it comes to building suitable harness for mounting a motor, although there are instances where home-made jobs are quite satisfactory.

Metal-turning lathes also usually offer some difficulty in mounting a motor without using a counter shaft, because it is often impossible to reduce speed sufficiently with one belt to make the lathe slow enough. Purchased equipment for mounting a motor on a lathe usually includes some type of suitable speed reducer for obtaining correct lathe speed without using a complicated system of belts. One company, and there are perhaps others, has a variable-speed unit to which the motor is directly connected. Then the speed reducer is belted to the machine being operated. This makes a neat, compact, and efficient installation.

Drill presses usually permit quite simple mounting of a motor, using either flat or vee-belts, depending on distance between pulley centers. An outboard bracket on which to mount the motor can usually be clamped or bolted to the upright members of a drill-press frame.

If total hours spent figuring a job, laying out and building necessary equipment to mount a motor on a machine are figured along with the cost of material used, it will ordinarily cost less to buy a ready-made harness. Sometimes, however, it might be possible to do the work when men would otherwise be doing nothing and use material that would otherwise be scrapped and motorize a



machine with very little added expense. This also depends on whether or not mechanics available are experienced in this type of work. An inexperienced mechanic without ingenuity can use lots of time and turn out an unsatisfactory job where a mechanic trained in that class of work and accustomed to using his head would turn out a good job at relatively low cost. W. L. COTTON

Buy Them If You Need Them

My answer to the question of motor mounts is: Better buy them if you are certain they are the answer to your problem, even though the cost of adapting and applying the motor and the mount to the machine may exceed the purchase price of the mount.

Personal experience with a few such jobs has caused me to design and build the mounts in some cases where I already knew the problems of that particular machine and there were enough machines to warrant the cost of drafting and patterns. I found it better to buy where I was exploring into unfamiliar territory or was uncertain about patent rights on such mounts and only had one machine of each type to change.

It is quite possible that attempting partly to modernize obsolete machines will cause more headaches than the present layout is causing, so there should be a pressing need for such a change, with no alternative available. Almost all such changes are made by machine-tool jobbers who dress up an obsolete machine discarded in favor of a modern machine with built-in motor drive, and then use the improvised individual drive as a sales appeal. In fact, the inquirer will find his best source of information on motorizing old machine tools in machine-tool jobbers' catalogs and sales rooms, and will find it advisable to visit such sales rooms before deciding the question of whether there is a good reason for the change or it is just an idea that individual drives will be better. Keep in mind that such a change cannot improve the machine itself, and that it will increase capital investment and will cause some obsolescence of other equipment.

Can you visit sales rooms or other shops to see the rig in action, so that you can be certain the mount you buy will fit your machine? It is quite likely that you can see which is best to buy and which is best to build, but it is more likely that you will consider more closely the advisability of buying a modern machine with individual motor drives built into it.

Do you have any personal friends, running their own shop, who have made these changes? I know three of them, and without exception they regret the changes. In fact, one of them had one of the best possible reasons for changing, namely, removal to a new and larger building where the cost of re-installing line and countershafts would help to offset the wiring costs, and his experience was most unfortunate. He sold good motors and shafting, hangers, countershafts and belting at about 40 per cent of new value and paid several thousand dollars for individual drives and costs of application. He then found he could not amortize the costs, because there was no increase in production from the machines. His power bill increased over 15 per cent, his maintenance charges were only reduced about 35 per cent, and he lost about a week's production with each machine while installing the new motor mounts.

There are some special cases where an improvised individual motor mount is obviously desirable. For example, a machine may have to be placed under a crane, or the portability of the machine may be necessary. When machine tools were scarce as they were in 1917 and 1941 there was need of using every available machine tool, regardless of efficiency, but even in this case the users should make certain that it is cheaper to use an improvised individual drive than a line shaft. Be sure you are not just throwing one thing away for another and that competent operators are available who can make full use of the machine. LINWOOD SKELLENGER

Railroads Not Manufacturers

There is some doubt as to just what is meant by the term "harness" as used in the above question. It probably refers to the mounting, gear reduction, and other mechanisms that will be required to install the individual motors on the several machines in the shop. Regardless of what is intended by the term, it can be said that it generally does not pay for a railroad's electrical shop to make any sizeable piece of equipment that can be purchased on the open market.

When an electrical repair shop builds equipment that could have been purchased from a catalog, they are usually wasting time and throwing away money. In the first place, someone has to do the designing. The design may be entirely in the mind of the foreman, or it may be a detailed drawing. In the first instance, the foreman has to convey his ideas to a mechanic, and this takes time. In the second instance, the draftsman has had to spend time on the design, and his salary should be charged to the job. Then the foreman or a mechanic has to find the material from which the article is to be constructed. And last but not least, someone has to get to work and build the device. In some railroad shops the labor for building the device may be charged to maintenance of equipment, maintenance of ways and structure, or some other account that will stand the extra charge. Nevertheless, the charge is there and the thing that has been made has actually cost the company a lot of money, even though it does not show in the accounts. If the machine really works, and works successfully, everything will be fine from here on, but in most cases there is a period of experimentation with any newly designed device. Sometimes the device has to be changed, and that may mean tearing down and rebuilding the whole machine. This will prove to be anything but an inexpensive procedure. Then there is always the possibility that the shop-made machine may be dangerous. It may fail and injure some of the personnel, or at least it might cause damage to other valuable machinery in the plant where it is installed.

Compare the above roundabout procedure, with the cost of looking up the best standard device in the catalog of a well known manufacturer, and the placing of a requisition for its purchase. The purchased device will in most instances be factory tested, and will prove entirely satisfactory. Furthermore, it will also cost less in the long run than the home-made device.

Sometimes maintenance and repair men are compelled to build something that would have been purchased if the "boss" had been willing to sign the requisition. Unwillingness on the part of railroad supervisors and officials to approve requisitions for necessary material, just because the price seems to be high in a short-sighted policy in many instances. Railroad employes are resourceful people and often they will get what they want regardless of the "boss" or the cost.

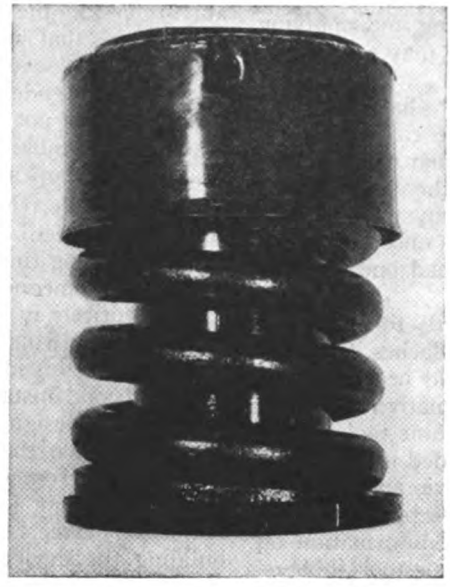
As to whether the "harness" should be built in your own shop, or purchased already built, it seems safe to say that if it is a standard catalog item, it should be requisitioned through the usual channels and the boss should approve the purchase. P. C. FREDKY

NEW DEVICES

Shock Absorber For Freight Cars

Based on experience gained in equipping a large percentage of all railroad passenger cars built since 1936 with hydraulic shock absorbers and a notable record as exclusive manufacturers of shock absorbers for U. S. tanks, jeeps, scout cars and heavy trucks, the Monroe Auto Equipment Company, Monroe, Mich., has recently announced the development of a new hydraulic shock absorber for freight cars. Specific objectives sought in the development of the new shock absorber are uniformly dependable performance in cushioning shocks to lading and car structures, quiet, efficient action, long life and general freedom from the necessity of servicing.

The new hydraulic shock absorber is a small, compact and self-contained unit, as shown in the illustrations, which replaces one conventional truck spring in the spring cluster supporting each end of the truck bolster. It offers hydraulic resistance to the compression movements and contains an external spring which carries part of the load imposed by the weight of the car and also returns the shock absorber to its original position. Hydraulic resistance inside the pressure chamber is controlled by a series of spring steel discs used in conjunction with a predetermined metered orifice. The control can be varied to meet any required condition by using the proper combination of orifice and pressure relief. The pressure chamber is surrounded by a large oil reservoir chamber to compensate for the displacement of the piston rod.

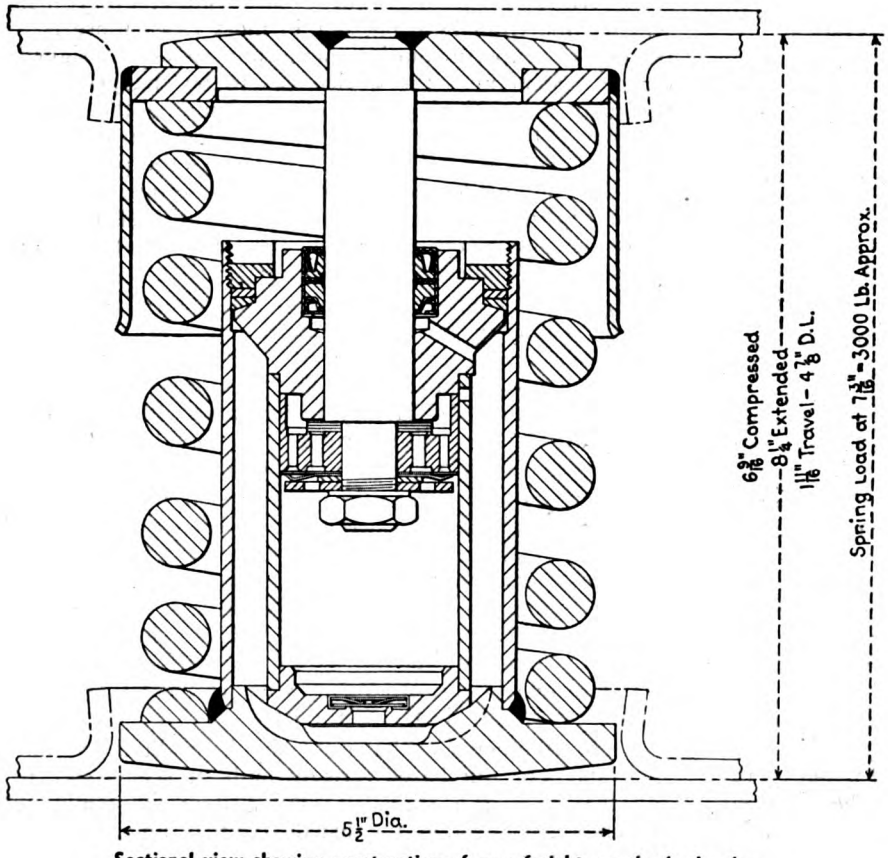


Hydraulic shock absorber for freight cars

In operation, oil passes from the reserve to the pressure chamber through a non-return valve in the lower part of the pressure chamber. The unit is a sealed assembly at the lower end so there can be no leakage at this point, and the upper end is sealed with synthetic rubber seals. This hydraulic shock absorber is said to utilize a type of oil which assures uniform action under all temperature and weather conditions.

Another new development of this company is a stabilizer designed to minimize the swaying of freight cars caused by track irregularities or curves. This device consists primarily of a torsion bar extending across each truck and connected between the bolster and truck frame in such a way that any tendency of the car body to rock on the truck centers is resisted by torsion in the bar. This type of device has demonstrated its value in passenger service.

In the field of passenger-car hydraulic shock absorbers, the Monroe Auto Equipment Company has also effected a number of improvements. The new shock absorbers are said to be lighter and more economical, both in original cost and in use, higher pressures are possible because of the closer tolerances and improved finishes on the pressure chamber, shaft guide, shaft, valves and valve seats.



Sectional view showing construction of new freight car shock absorber

A Slide Rule That Locates Decimal Points

A Decimal Point Locator and slide rule that will determine the decimal point mechanically in involved expressions with results up to 19 places is announced by Pickett & Eckel, 53 W. Jackson Blvd., Chicago 4.

The device so simplifies slide-rule calculations that persons with a very limited mathematical background can evaluate and point off problems containing cube root, square root, log and trigonometric factors.

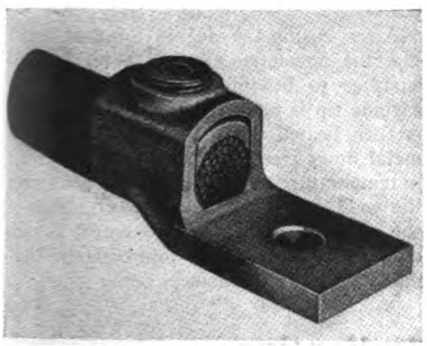
The streamline functional design of scale arrangements on the Decipoint slide rule gives the computor five distinct advantages over old style slide rules: (1) Places decimal point with mechanical accuracy up to 19 places in involved expressions (0.00000000000000000001496); (2) gives 30-in. scale accuracy for cube root; (3) gives 20-in. scale accuracy for square root; (4) synchronized scales permit result, square root, cube root, and log readings to be taken off the same one setting of the hairline; and (5) one setting of hairline of the Decipoint locator (which can be used with any slide rule) also determines the decimal point location of result, square root, and cube root, up to 19 places.

The illustrated instruction Manual, written by M. L. Hartung, associate professor of the Teaching of Mathematics, the University of Chicago, gives instructions for beginners, rules for operating the Decimal Point Locator, and presents the mathematical theory of mechanical decimal-point location.

These rules are now made of a high grade tag stock varnished to render them moisture proof. They have been found to maintain their accuracy under daily use for over a year. As soon as the war situation permits, they will be offered in plastic form, under a trade-in arrangement with owners of the present less-durable models.

Connector Lug

A solderless lug that will accommodate more than one size of wire, designated as the Type XL lug, has been developed by the O. Z. Electrical Manufacturing Co., Brooklyn, N. Y. It is made of cast copper



The lug is designed to accommodate various sizes of wires

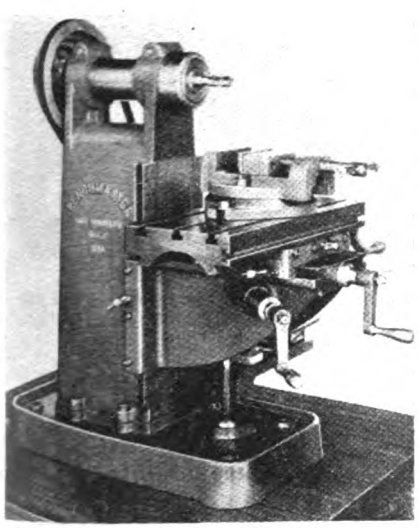
alloy, and clamping pressure is exerted by a pressure plate which insures high conductivity on conductors in a wide range of sizes. Socket wrenches are furnished without cost.

A Bench Milling Machine

A precision-engineered bench model milling machine made by the Benchmaster Manufacturing Company, 2952 West Pico boulevard, Los Angeles 6, Calif., is speedily and easily converted from a vertical to a conventional horizontal machine with overarm and arbor by simply interchanging the spindle attachments. In either position the Benchmaster mill is equally adapted to precision tool work, or high-speed production by equipping it with a rack and pinion feed in place of the hand feed. A variety of jobs such as precision die making, die sinking, slotting, facing, side milling, key seating, jig boring, angle slotting, etc., can be handled without tying up a large machine.

Features of the design are the ball thrust bearings on the vertical lead screw; gib locks on the table, a saddle and knee for insuring accuracy once the machine is set up; and an equalized weight distribution that provides rigidity enough to do heavy work accurately yet allows for great ease of handling.

The horizontal mill includes an overarm attachment for outboard support for the end of the arbor. The vertical mill attachment features a spindle arm which swings 60 deg. each side of center, graduated in degrees.



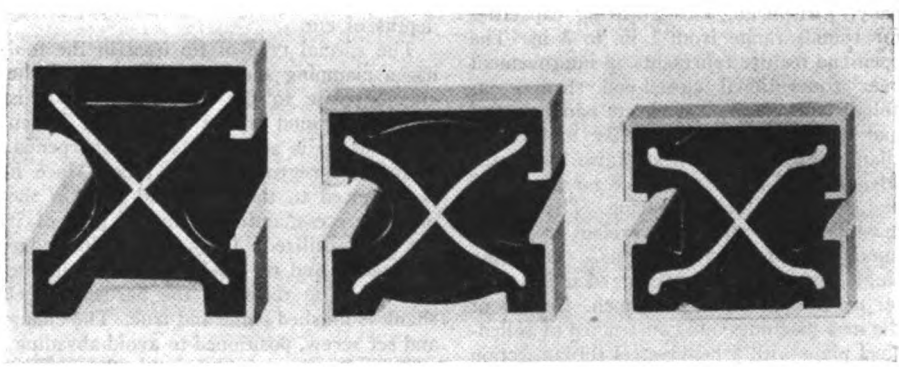
Bench model milling machine

Vibration Mount

Rexon, a new type of vibration mount, characterized by simplicity in design and application, and by virtual indestructibility in use, has just been announced by Hamilton Kent Manufacturing Company, a unit of U. S. Stoneware, Akron, Ohio. Only two standard types of mountings are required to isolate vibration effectively. All that an engineer need know is the total weight, the weight distribution of the machine to be insulated, and whether the direction of the vibration is vertical or horizontal. Loading is not critical, a tolerance of plus or minus 10 per cent in computing machine weight or weight distribution is permissible.

Rexon utilizes the vibration-dampening properties of rubber in shear. The shear elements cannot be overloaded. This property comes from the use of a special X-type design of the rubber element which acts in shear at the points of the X under normal loading, but in compression when the load exceeds the rated capacity of the mount. The mounts cannot be damaged by temporary or permanent overload. No rubber-to-metal bonds, either mechanical or chemical are used.

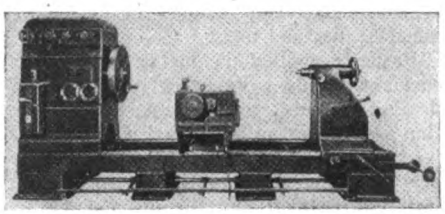
The internal dampening characteristics of the mounts virtually eliminate any problem of resonance as they have no critical frequency points. The mounts can be easily and quickly installed without use of special angles, brackets or radius rods, and without increasing the overall height of a machine more than 1½ to 2 in.



Left: Vibration mount unloaded—Center: Under normal load—Right: Overloaded

Armature Banding Machine

An armature banding machine called the extra heavy duty type H Peerless is now being made by the Electric Service Manufacturing Company, Philadelphia, Pa. It



Peerless heavy-duty type HL armature banding machine

is designed exclusively for banding armatures and particularly those that are too large to be handled by the types H and EH machines made by this company. This machine also incorporates a speed control which offers a large number of speeds combined with a swing of 55 in. diameter and a length between centers of 72 to 96 in. and a torque capacity of 12,000 lb.

The bed consists of heavy iron channels connected by iron castings and supported on cast-iron pedestals. The bed is completely machined on the outside, giving an accurate surface for the carriage travel.

The headstock consists of a variable-speed transmission mounted on a rugged iron casting in which is supported the main spindle, clutch, brake shaft and worm shaft. The main spindle is mounted on Timken roller bearings, the clutch and brake shaft on ball bearings. The casting also encloses the main drive motor which is mounted on a pivoted base to allow for belt take-up.

A multiple V-belt drive transmits power from the main motor to the constant-speed shaft of the transmission and a silent-chain drive upon the variable-speed shaft of the transmission to the clutch shaft. The clutch and brake shaft and the worm shaft operate in oil. The main spindle is fitted with a No. 5 taper center and 24-in. diameter plate.

Hard-Facing Alloy

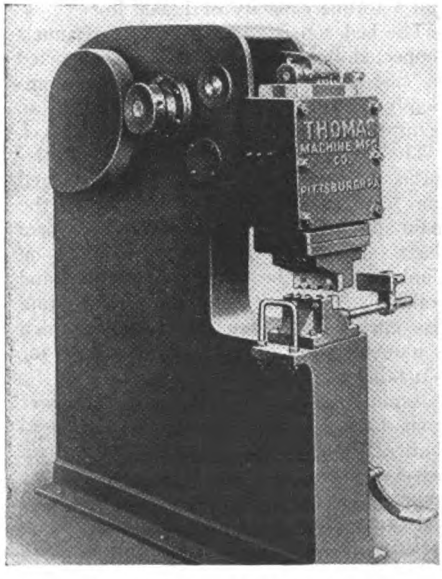
A non-ferrous hard-facing metal has been placed on the market by the Fansteel Metallurgical Corporation, North Chicago, Ill., under the name Fanweld. The metal is intended for acetylene torch application to steel, and possesses marked resistance to abrasion, heat, impact and erosion.

This metal contains tantalum-columbium carbide which is said to impart a peculiarly self-lubricating action, minimizing the destructive effects of friction even at elevated temperatures. Tests indicate that it is unusually well suited for hot-work punches, dies and tools.

Properly applied the metal "wets" steel surfaces readily without the use of a flux, flowing smoothly and evenly. Surfaces as thin as .010 in. can be applied with a fusion layer as thin as .0005 in. No hardening or heat treating operations are necessary. Fanweld is made in 3/16 in. and 1/4 in. diameter rods in 14 in. lengths.

Open-End Bar Shears

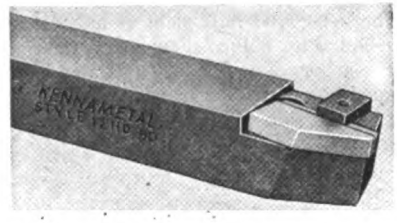
A line of open-end vertical bar shears, designed in 10 sizes and with ram pressures of from 25 to 300 tons, has been announced by Thomas Machine Manufacturing Company, Pittsburgh, Pa. Shearing capacities for rounds range from 1 in. to 3 in. The open-end feature represents an improvement over conventional closed-end shears, enabling quicker, more accurate handling and making the shear blades easy to see and change. The new shears also have the advantage of being adaptable for punching, and plate and angle shearing. The ram is machined for attaching various types of punching-tool arrangements, including single, double- or triple-gagged units, cluster punches or a floating punch. Frames of the new machines and constructed of rolled-steel plate with a heavy-steel throat section welded into place. The multiple-jaw clutch has a positive automatic kickout for stopping the ram at the top of the stroke. The flywheel is mounted in roller bearings located within the frame for safety and to eliminate overhung load on the bearings. A V-belt motor drive provides quiet operation and reduces shock load on the motor.



Open-end vertical bar shear

Tool Tips Clamped in Holder

Kennametal, Inc., of Latrobe, Pa., is now producing a line of tools having clamped-in and advanceable Kennametal tips, for heavy-duty machining on steel castings, forgings, bar stock and cast iron. The design has been made possible by the development of heavy-duty Kennametal tips, that, while overhanging the tool shank by about 1/16 in., have ample strength to take heavy feeds and depths of cut.



Tool tips in this holder can be advanced to compensate for wear until major portion of the tip is worn away

The special type of tip used in the tool has a clamping shelf along the top of the side opposite to the cutting edge. It is diamond ground on the under side. When dull, the tip is advanced, and resharpened. It may be reground many times, since it is advanced to the front and side, in the oblique recess, until the major part of it has been utilized. Only the cutting edge is ground, and no steel is removed in the process. The recess in the hardened-steel shank is finished plane and true. The clamp and set screw, positioned to avoid abrading, permit smooth, unimpeded chip flow.

Use of these tools permits carrying minimum tool stocks, since one shank serves for the life of many tips, and the proper grade of tip can be used for each job. Heavy-duty Kennametal tips are available in Grades KM and K3H for general steel cutting, Grade K2S for machining steel castings where scale is encountered, and Grade K6 for cast irons. The tools are made in several styles in the larger sizes with shanks 1 in. wide, or more.

Tipping Carbide Tools

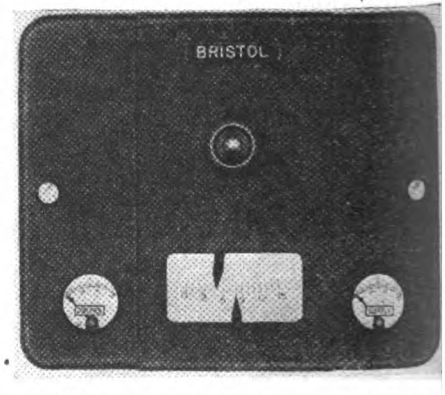
Tools tipped with carbide and high-speed steel are generally prepared by preplacing a strip of brazing alloy, together with a sufficient amount of flux, between the tip and the shank. The assembly is then placed in a furnace, or heated with an induction coil. This procedure, however, is sometimes objectionable, as the foil may become tarnished or oxidized and then require a temperature considerably above its own melting point to flow freely. Alloys in powder form present definite advantages over the use of silver brazing alloys in the form of foil and the Eutectic Welding Alloys Co., New York, has developed two silver-copper and one copper alloy used for tipping tungsten-carbide and high-speed-steel tools which are now available in a fine powder. The required flux is mixed with the powdered alloy, which eliminates any waste of flux during preparation. Nor does the powder require the special handling necessary for cutting the foil into small pieces for exact pre-placing. The alloys and furnace temperatures which they require are:

EutecRod 1800 (lowest-melting) for high-speed steel, deg. F.	940-1,140
EutecRod 1601 (high-tensile) for tungsten carbide, deg. F.	1,020-1,250
EutecRod 16 (heat-resistant, for tungsten high-tensile) carbide, deg. F.	1,300-1,750

After customary degreasing and grinding, the powdered alloy is spread on the surfaces to be joined, and the tungsten-carbide tip is placed on top. The assembly is then heated until the alloy melts. The metal flows freely at a very slight increase in temperature above the melting point since the weld metal is pulverized. Oxidation of the tungsten carbide is prevented, as each particle of molten alloy immediately "tins" and adheres to the surfaces being joined.

Indicating Control Instruments

The Bristol Company, Waterbury, Conn., has announced the development of a new series of indicating air-operated control instruments. The instruments, known as the model 93 series, are built for controlling temperature, pressure, vacuum, liquid level, and humidity. They operate on the free-vane principle of automatic control. They have a throttling range of from ½ to 15 per cent with the adjusting mechanism arranged so that changes in the throttling range can be made by the user without the need of tools. Being direct set instruments they can be set to control at any value within the range of the instrument by turning the control pointer to the desired value. They are built so that they can be changed by a finger adjustment from reverse to direct action or vice-versa.



Bristol model 93 indicating air-operated control instrument

Typical applications are the control of temperatures in ovens, cookers, retorts, plating tanks, and soft-metal pots and the control of steam pressure, pressure in retorts, and back pressure.

NEWS

W. B. Holton Elected President Valve Manufacturers Assn.

W. B. HOLTON, JR., president of the Walworth Company, has been elected president of the Valve Manufacturers Association to succeed Ernest Cochran, vice-president of the Chapman Valve Manufacturing Company.

Samuel C. Prest

SAMUEL C. PREST, who has been appointed engineer of tests of the Association of Manufacturers of Chilled Car Wheels with offices at Chicago, as noted in the March issue, entered the employ of the Griffin Wheel Company as an inspector in

Samuel C. Prest

1933 following his graduation from the University of Chicago. He subsequently became general inspector and served in that position until November, 1935. From 1935 to 1937 he was in the research department of the Association of Manufacturers of Chilled Car Wheels where he assisted in the development of the unit-pit type of annealing, now standard with the car wheel industry. He returned to the Griffin Wheel Company at the end of 1937 and until joining the Association of Manufacturers of Chilled Car Wheels, had been on the staff of the Cupola division, engaged in special work relating to cupola operations of Griffin plants. In addition he actively assisted in special studies being carried on by committees of the wheel association leading to changes in the design and specifications for the manufacture of chilled car wheels.

Hearing on AB Brakes Set for April 17

UPON the request of the Association of American Railroads, a hearing on the Interstate Commerce Commission's No. 13528 proceedings, concerning the application of power brakes to freight cars, has been set for April 17 at the Morrison Hotel, Chicago, before Commissioner Patterson. In making this announcement for the commission, Secretary W. P. Bartel added that the last day for filing briefs in this proceeding has been postponed from January 31 to a date yet to be fixed.

This hearing is the result of a show cause order served on the railroads on July 29, 1944, requiring returns to the proposal that installations complying with certain specifications made by the commission should be completed by January 1, 1946.

Car Research Program Discussed at Purdue

THIRTY-four representatives of railway material suppliers, the Association of American Railroads, the American Railway Car Institute, and Purdue University met, at the invitation of Dean A. A. Potter, on March 7, 1945, at Lafayette, Ind., to discuss a program of research intended to furnish factual data useful in the design of modern railway cars. The discussions at this conference brought out the importance of utilizing recent developments in instrumentation and techniques to secure an accurate picture of the factors essential for the most effective utilization of different materials in modern freight car design, and of the desirability of tests on complete cars. It is expected that this conference will result in a research program of special interest to the railroads as well as to those who supply railway car materials.

Second-Quarter Equipment Program Cut 30 Per Cent

BY "slashing" the claims of the Office of Defense Transportation for second-quarter allocations of controlled materials for use in the production of civilian transportation equipment, the War Production Board has made the deepest cut in the O. D. T.'s quarterly program since the fall of 1943. This cut, which amounts to about 30 per cent on the basic carbon steel allocation, affects all civilian transportation agencies, for which the O. D. T. is the designated claimant agent, and particularly the railroads.

In explanation of the W. P. B. action, O. D. T. Director Johnson said it was due to the "heaviest military requirements for steel since the beginning of the war." The cut in allocations was a subject of discussion at the monthly meeting of the directors of the Association of American Railroads in Washington, D. C., February 23, at which time Colonel Johnson pointed out that the performance records made by the carriers in this war probably will have to be exceeded if they are to meet the greater demands that this year's traffic will make upon them.

The equipment program outlined by the O. D. T. called for an allocation of 1,527,000 tons of carbon steel in the second quarter of this year. The W. P. B. allowed only 1,065,000 tons. The first quarter allotment was 1,254,838 tons.

The effect of this reduction in the allocation of carbon steel on the production of materials and equipment for railroad motive power and rolling stock was outlined by the O. D. T. as follows:

Freight Cars.—To provide for a planned quarterly production of 13,500 cars the O. D. T. has requested an allotment of 250,000 tons of carbon steel. This was cut to 135,000 tons, from which it is estimated 7,500 cars can be fabricated. The O. D. T. indicated that most of these will be box cars.

Locomotives.—Without detailing its program, the O. D. T. gave the second quarter carbon steel allocation as 30,000 tons.

Passenger Cars.—As previously announced, the O. D. T. program for the production of passenger cars in 1945 contemplated an output of 250 cars per quarter, and some materials were allocated by the W. P. B. for the first quarter schedule. For the second quarter, however, no steel was provided for passenger cars, as that phase of the program was disapproved entirely by the W. P. B., except that 252 tons was allotted for the production of 15 baggage and mail cars.

Canadian Pacific Sets Up Research Department

WITH a view to meeting postwar competition through an intensive practical research into all matters of railway operation, the Canadian Pacific recently organ-

W. A. Newman

ized a new department of research, under the direction of W. A. Newman, who was for some years chief mechanical engineer of the railway. Since June, 1943, he has been on loan to Federal Aircraft, Ltd., and since October, 1944, has been in charge of the entire aircraft industry in Canada. It will be the duty of the research department to eliminate waste of effort and material, and so to develop and improve existing

facilities and services as to anticipate all contingencies.

In addition to his new position, with the Canadian Pacific, Mr. Newman will continue his war-time duties as aircraft controller of Wartime Industries and Control Board in the Department of Munitions and Supply, and as administrator for the Wartime Prices and Trade Board.

Mr. Newman joined the mechanical department of the Canadian Pacific 34 years ago as an apprentice in the Angus shops, following his graduation from Queen's University. He subsequently served as draftsman, supervisor of betterments, assistant mechanical engineer, locomotive construction engineer, and locomotive and car construction engineer until 1928 when he was appointed mechanical engineer.

Veale Elected President of Pacific Railway Club

C. A. VEALE, vice-president and general manager of the Northwestern Pacific, was elected president of the Pacific Railway Club at the twenty-eighth annual meeting of that organization, held in San Francisco, Calif., on March 8. Other officers elected were: W. T. Richardson, division engineer of the Western Pacific, vice-president; H. E. Jordan, superintendent of equipment of the Los Angeles Transit Lines, vice-president; H. R. Fegley, assistant to the general manager, Western Pacific, vice-president, and George C. Fish, superintendent, Union Pacific, vice-president. William S. Wollner was re-elected executive secretary of the club.

Bureau of Safety Report

THE annual report of the Bureau of Safety, Interstate Commerce Commission, for the fiscal year ended June 30, 1944, is a 39-page document setting forth in the usual form the results of inspection of safety-appliance equipment on railroads together with information on hours-of-service records of employees, installations of signaling facilities, investigations of accidents, and other activities of the bureau. The results of inspection of equipment are given as follows:

During the fiscal year a total of 1,456,317 cars and locomotives was inspected, and 44,204 or 3.03 per cent were found defective. That is the highest defective percentage of the 1935-1944 decade, the nearest approach being fiscal 1941's 2.91. The percentage for fiscal 1943 was 2.82. Included in the rolling stock inspected in fiscal 1944 were 33,669 passenger-train cars, of which 930 or 2.8 per cent were found defective, 1,268 defects being reported.

Air-brake tests were made on 3,870 trains, consisting of 170,473 cars, prepared for departure from terminals; and air brakes were found operative on 170,296 or 99.9 per cent of these cars. This percentage was attained, however, only after 1,907 cars having defective brakes had been set out, and repairs had been made to the brakes on 1,881 cars remaining in the trains. Like its predecessors, the report emphasizes this situation, saying: "These trains had been prepared for departure; yet when afterward tested by our inspectors it was necessary to set out or to repair the brakes on an average of one car per train."

Similar tests on 1,812 trains arriving at terminals with 92,371 cars showed that the air brakes were operative on 98.19 per cent of the cars. Cars with inoperative brakes averaged approximately one per train, the same as in the preceding year.

Commenting on the program for equip- that the year brought an increase of 137,517 ping cars with AB brakes, the report notes in the number of cars thus fitted—42,844 of them being new cars. It also notes that "during 9½ years, or 95 per cent of the 10-year period allotted for making this improvement only 45.4 per cent of the freight cars in interchange service have been equipped with the present standard air-brake apparatus. Meantime, as the report further points out the commission on July 29, 1944, issued its order requiring the carriers to show cause why all freight cars should not be required to be equipped by January 1, 1946.

The bureau has continued its cooperation with the Association of American Railroads with respect to test of geared hand brakes. Thus far 12 types of vertical-wheel geared brakes have been certified as conforming to A. A. R. requirements; and final action on other than vertical-wheel types is pending. The A. A. R. has also certified five designs for metal running boards for freight cars.

Alleged violations of safety appliance laws in 284 cases comprising 803 counts were transmitted to United States attorneys during the year. The report's section on the bureau's accident-investigation work shows that 102 accidents were investigated during the year; in them 377 persons had been killed and 1,722 injured.

Responding to requests of proprietors or their agents, the bureau, during the year, examined plans and specifications and rendered opinions on 12 safety devices. Among these were six devices for prevention and detection of hot journals, and one safety guard for car wheels.

Orders and Inquiries for New Equipment Placed Since the Closing of the March Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Chesapeake & Ohio	10	4-8-4	Lima Loco. Wks.
Chicago & Eastern Illinois	2[1]	2,000-hp. Diesel-elec.	Electro-Motive
Chicago, Rock Island & Pacific	10[2]	Steam	American Loco. Co.
Great Northern	6[3]	2,700-hp. frt.	Electro-Motive
	6[3]	1,000-hp. switchers	Electro-Motive
	3[3]	1,350-hp. A units	Electro-Motive
	10[4]	1,000-hp. road and switching	Electro-Motive
Pennsylvania	25	4-4-4-4	Baldwin Loco. Wks.
	25	4-4-4-4	Co. shops

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Chicago, Milwaukee, St. Paul & Pacific	1,000[5]	50-ton box	Co. shops
Donora Southern	50	70-ton hopper	American Car & Fdy.

LOCOMOTIVE INQUIRIES

Missouri Pacific	4[9]	4,000-hp. Diesel-elec.
Texas & Pacific	3[9]	2,000-hp. Diesel-elec.
Great Northern	500[6]	Box ..... Co. shops
Pennsylvania	500	50-ton box ..... Co. shops

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Central of Georgia	1[7]	Pass-bagg.	Edw. G. Budd
	2[7]	Coaches	Edw. G. Budd
	1[7]	Observation-lounge	Edw. G. Budd
Chicago & Eastern Illinois	10[1]		Pullman-Standard

PASSENGER-CAR INQUIRIES

Pennsylvania Richmond, Fredericksburg & Potomac Seaboard Air Line	48[8]	
Missouri Pacific	32	Sleeping
	2	Sleeper-lounges
	2	Diners
Texas & Pacific	5	Diner-lounge
	21	Coaches
	8	Exp.-bagg.-mail

[1] For two new streamline trains. Cars to include one diner and one lunch car. Delivery of the cars dependent upon W. P. B. authorization of their construction. Trains for service between Chicago and Evansville, Ind., and between Chicago and Thebes, Ill.

[2] Authorization received from Federal Judge. Total cost $2,000,000. Ten similar locomotives were purchased last May, but increased traffic demands necessitated purchase of 10 additional units.

[3] For delivery this year.

[4] For delivery in first quarter of 1946.

[5] Order unconfirmed.

[6] Materials ordered for the construction of these cars during fourth quarter 1945. 1,000 plywood cars now completed.

[7] Authority granted by Federal Court for southern district of Georgia. The four cars will be streamlined, of stainless-steel construction, and air-conditioned. The 2,000-hp. Diesel-electric locomotive has been purchased from Electro-Motive.

[8] Bids closed March 16. Cost of the cars, to be constructed of light alloy, high-tensile steel framing with stainless-steel sheathing, is estimated at $3,840,000 or about $80,000 per car. The Seaboard and Pennsylvania will purchase 40 of the cars and the R. F. & P. the remaining eight. Acceptance of a bid for the Seaboard's share is contingent upon court approval of the proposed contract. The Seaboard plans to use the new coaches between New York and Florida and between New York and Birmingham, Ala. Between Richmond, Va., and Washington, D. C., the Seaboard uses R., F. & P. tracks and between Washington and New York, Pennsylvania tracks. The eight cars to be ordered by the R. F. & P. are the first of 19 authorized by the road's directors for postwar use.

[9] Purchase of equipment by Missouri Pacific authorized by Federal Judge at St. Louis, Mo.; purchase of equipment by Texas & Pacific approved by company's directors. According to Missouri Pacific statement, the equipment, which will comprise four trains for over-night service from St. Louis to many of the principal points in Texas, will cost $9,000,000. Orders are to be placed in the near future in order to insure earliest possible delivery dependent upon allocation of now critical materials by the War Production Board.

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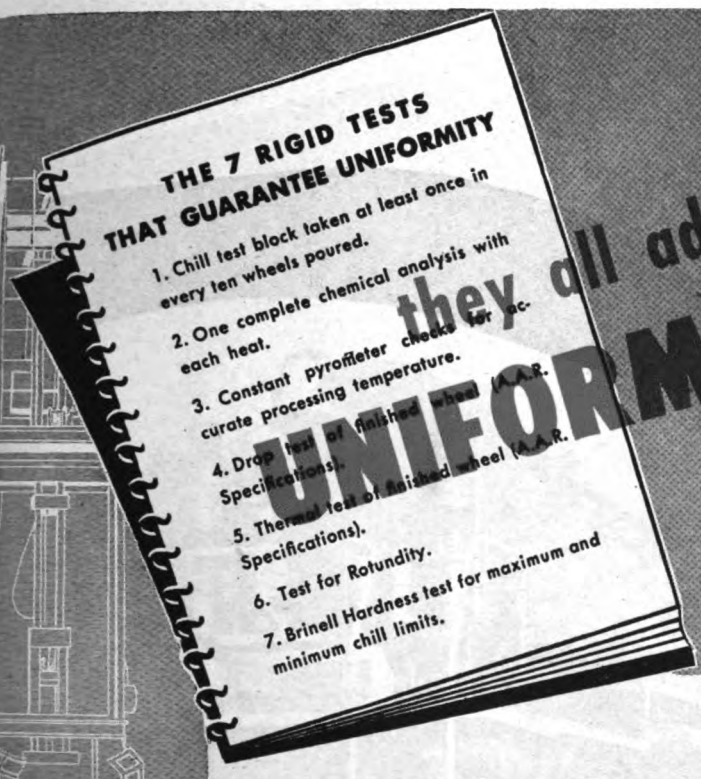

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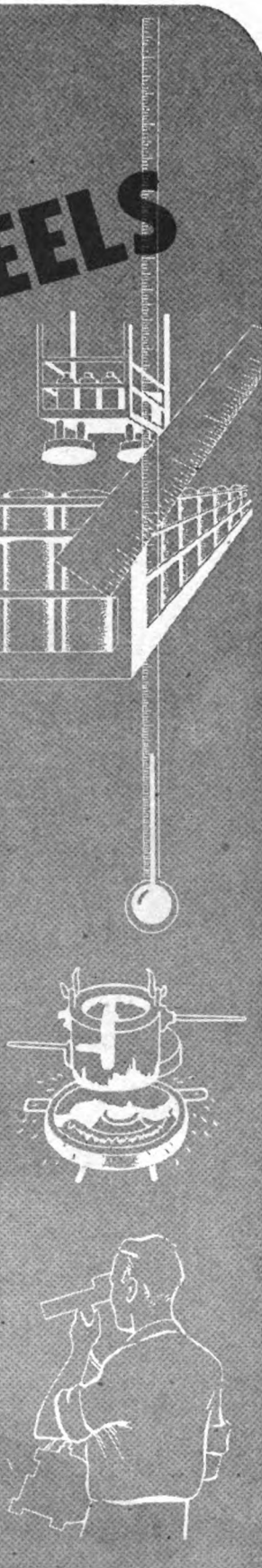
• These seven tests translate an aim into an accomplishment. As a firmly-established part of the AMCCW Code of Practice, they assure all railroads of chilled car wheels which are uniformly good.

One by one, in previous advertisements, we have pointed out the purposes of individual tests . . . emphasized the thoroughness with which they are carried out . . . mentioned some of the fields such as optical pyrometry and micro-photograhy which have contributed to this thoroughness.

This series of tests illustrates the high standards to which our member manufacturers subscribe and to which they must adhere in order to remain members. The end-result of such adherence is product uniformity — a practical aid to today's railroads in the great wartime job they are doing.



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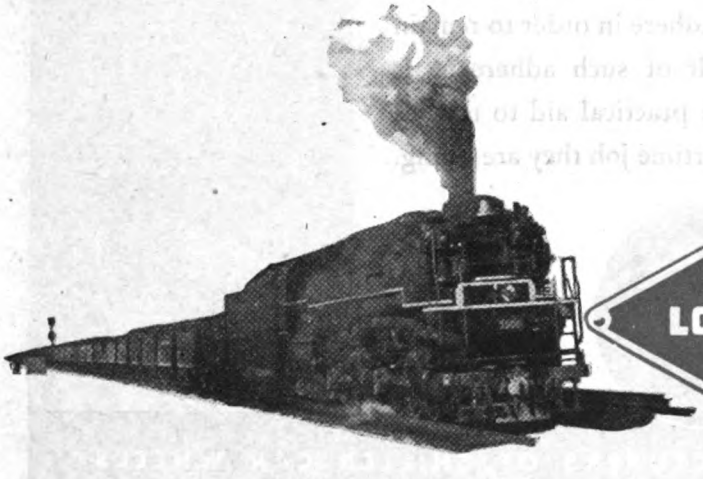

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LOCOMOTIVE WORKS
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LIMA LOCOMOTIVE

THE C AND O was ready!

Realizing the tremendous role that coal plays in modern warfare, the Chesapeake & Ohio had the foresight to plan far in advance for motive power to handle the vastly increased tonnage of coal which must be speeded over its lines.

Five years ago the C & O ordered ten 2-6-6-6 Lima Locomotives, specially designed to haul heavy trains over the steep grades of the Allegheny Mountains. This fleet has been steadily augmented until forty-five of these "Allegheny" type giants are now moving the coal so vital to the successful carrying on of the war.

High efficiency and low maintenance costs are two outstanding features of this locomotive.

WORKS, INCORPORATED LIMA, OHIO

Supply Trade Notes

MORRISON RAILWAY SUPPLY CORPORATION.—The Morrison Railway Supply Corporation has moved its Chicago office to 322 South Michigan avenue.

◆

PARKER-KALON CORPORATION.—*S. S. Kahn,* assistant sales manager, has been appointed sales and advertising manager of the Parker-Kalon Corporation, New York, to succeed the late Charles S. Trott.

◆

WARREN TOOL COMPANY.—*Karl F. Baumann,* assistant to the vice-president in charge of sales of Globe-Union, Inc., has been appointed assistant sales manager of the Warren Tool Corporation.

◆

FLANNERY BOLT COMPANY.—*W. B. Peirce* has been appointed vice-president of research and development of the Flannery Bolt Company, Bridgeville, Pa. *Dr. G. R. Greenslade* has been appointed director of research; *F. K. Landgraf,* vice-president of engineering, and *W. C. Masters,* sales manager.

W. B. Peirce served his apprenticeship with the Baldwin Locomotive Works, and later was night superintendent. He then became general superintendent of the Buf-

W. B. Peirce

falo Bolt Company at North Tonawanda, N. Y. Shortly after the last war he was appointed works manager of the Graham Bolt & Nut Co., at the time Jones & Laughlin made an investment there for the purpose of expanding the Graham Company's activities. He continued with the Pittsburgh Screw & Bolt Corp. after their absorption of the Graham Bolt & Nut Co., subsequently transferring to the Flannery Bolt Company as works manager.

Dr. G. R. Greenslade is a graduate of Whitman College, Washington University and Wisconsin University, and holds the degrees of bachelor of science, master of science, master of arts and doctor of philosophy. He was formerly fellow of the department of physics at Wisconsin University. During the first world war he served as director of the school of electronics and radio communication at the Madison, Wis., cantonment. He has taught physics and engineering subjects at four colleges and universities; was in charge of the research problem of diffusivity and con-

G. R. Greenslade

ductivity as related to the diurnal heat cycle of the Holland vehicular tunnels between New York and New Jersey; and has collaborated with the U. S. Bureau of Standards and the laboratories of the General Electric Company. He also served with the U. S. Bureau of Mines as chief of the physics section of the Pittsburgh, Pa., station, and later for two years as consulting physicist. Dr. Greenslade has been in the employ of the Flannery Bolt Company for some years, serving as chief physicist and as research engineer. He has received over fifty United States and foreign patents on his inventions.

F. K. Landgraf

F. K. Landgraf is a graduate of Wisconsin University. In the interests of James J. Flannery Mr. Landgraf went to Pittsburgh in 1903 as mechanical engineer for the American Vanadium Company. He became associated with Flannery Bolt Company upon its formation in 1904 as a draftsman and later served as superintendent, general superintendent and chief engineer. He has designed and built many of the m chines used in the production of the co pany's wartime and commercial produc and has contributed towards the ma patents which the company owns coveri these devices.

W. C. Masters received his education the Carnegie Institute of Technology. H has been active in the operation of seve plants and more lately has specialized the technical and metallurgical aspects the business. He was loaned by the Graha Bolt & Nut Company for a period of yea to the Bolt, Nut and Rivet Institute, ser ing as technical advisor. He was sal

W. C. Masters

engineer in the employ of the Townse Company for a short time and, in 19 joined the Flannery organization.

◆

LINCOLN ELECTRIC COMPANY.—*W. Persons* has been appointed assistant sal manager of the Lincoln Electric Compan Cleveland, Ohio. Mr. Persons has be with the company for the past ten yea He is a graduate of the Case School Applied Science. He took the Lincoln Ele tric Company's welding course and subs quently was assigned to the position sales and service representative in weste Pennsylvania. He was appointed bran manager of the company's Pittsburgh, P office four years later, and in 1944 w transferred to the home office at Clevelan where he worked on special assignment Mr. Persons is chairman of the company junior board of directors.

◆

INLAND STEEL COMPANY.—The Inlan Steel Company, Chicago, has established metallurgical and inspection department b merging the activities of its Indiana Harbo works metallurgical department, its In diana Harbor works inspection departmen and its general office department of inspe tion and metallurgy. The purpose of th consolidation is to effect a unified contr over all of the metallurgical and inspectio services of the company and to obtain mo complete correlation of these activities.

(*Continued on next left-hand page*)

THE FRANKLIN SYSTEM OF STEAM DISTRIBUTION

The Outstanding Development in Locomotive Design

The Franklin System of Steam Distribution has eliminated the restriction on power output imposed by conventional systems of steam distribution.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.
NEW YORK • CHICAGO
In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

Hunter Nead, chief metallurgist, has been appointed manager of the new department, with headquarters at Indiana Harbor, Ind., while *E. D. Martin* and *T. S. Washburn* have been appointed assistant managers at the Indiana Harbor works and the general office in Chicago, respectively. *L. S. Marsh,* manager of the general office department inspection and metallurgy, will continue in a special metallurgical advisory and consulting capacity.

◆

THOMAS MACHINE MANUFACTURING COMPANY.—The Thomas Machine Manufacturing Company, Pittsburgh, Pa., has announced the appointment of sales agencies in 16 major cities to handle Thomas equipment for all of the United States east of the Mississippi river. Similar agencies for territory west of the Mississippi will be announced shortly. The new agents are: the *General Machinery Corporation,* Boston, Mass.; *Giebel, Inc.,* New York and New Haven, Conn.; the *C. H. Briggs Machine Tool Co.,* Syracuse, N. Y.; *W. W Wentz,* Rochester, N Y.; the *J. L. Osgood Machinery & Tool Co,,* Buffalo, N. Y.; the *L. A. Benson Company,* Baltimore, Md.; the *Smith Courtney Company,* Richmond, Va.; the *Chandler Machinery Co.,* Atlanta, Ga.; the *George D. Miller Company,* Cleveland, Ohio; the *Brokaw Machinery Co.,* Cincinnati, Ohio; *Joseph Monahan,* Grand Rapids, Mich.; the *Bryant Machinery & Engineering Co.,* Chicago; *Quinn & Quinn,* Birmingham, Ala.; the *Noland Company,* Chattanooga, Tenn.; and *Frederic & Baker,* Shreveport and New Orleans, La.

◆

WESTINGHOUSE AIR BRAKE COMPANY.—*G. L. Cotter,* western district engineer, has been appointed assistant manager of the western district, with headquarters at Chicago. Mr. Cotter is a graduate of Michigan University with a degree in mechanical engineering. He joined the Westinghouse Air Brake Company at Wilmerding, Pa., in 1923, and after serving in the test and engineering divisions, was appointed district engineer for the central district, Pittsburgh, Pa., and, in 1940, head of the commercial engineering division in Wilmerding. He was transferred to Chicago as western district engineer in 1943.

W. V. WALKINSHAW has been appointed manager of industrial sales, with headquarters at the company's general office at Wilmerding, Pa., to succeed the late Roland G. Justus.

◆

BENDIX AVIATION CORPORATION.—*Arthur C. Omberg* has been appointed chief research engineer of the Bendix Radio division of the Bendix Aviation Corporation, and *Dr. Harold Goldberg,* formerly senior engineer of the Stromberg-Carlson Company, has been appointed a research engineer on the Bendix Radio staff.

◆

AMERICAN STEEL & WIRE COMPANY.—*Harold Martin* has been appointed assistant manager of New England sales by the American Steel & Wire Co., U. S. Steel subsidiary. He will continue to be located in the Boston, Mass., sales office where he has been manager of merchant product sales since March, 1942.

COPPERWELD STEEL COMPANY.—*Louis McGuire,* formerly manager and operating superintendent of an electric system in Tennessee, has been appointed sales engineer for the Copperweld Steel Company, Glassport, Pa., to cover the states of Tennessee, Mississippi and Alabama. Mr. McGuire will make his headquarters in Birmingham, Ala., and will be under the jurisdiction of Copperweld's Memphis, Tenn., office.

◆

GOULD STORAGE BATTERY COMPANY.—*Richard A. Rowland* has been elected vice-president of the Gould Storage Battery Corporation (the Gould Industrial division of the National Battery Company), with headquarters at Depew, N. Y. He succeeds *H. G. Barnes,* whose promotion to vice-president in charge of sales of the parent organization was reported in the March issue. Prior to his new connection Mr.

Richard A. Rowland

Rowland was vice-president of the Saint Paul Engineering and Manufacturing Company, St. Paul, Minn.

◆

LUKENS STEEL COMPANY.—*Edward J. Charlton,* who since 1942 has been assistant to the president of Lukenweld, Inc., has been appointed manager, development engineering, for the Lukens Steel Company and its subsidiaries, By-Products Steel Corporation and Lukenweld, Inc. Mr. Charlton was born in Philadelphia, Pa., where he attended high school and the Drexel Institute of Technology. Upon graduation from Drexel he entered the employ of Shepard Niles Crane and Hoist Company. In 1931 he joined the engineering staff of Lukenweld as a designing engineer, and in 1940 became general manager of Lukenweld, Inc. Mr. Charlton is a member of the American Society of Mechanical Engineers, the American Welding Society, and the American Society of Naval Engineers.

Army-Navy "E" Awards

Clark Equipment Company, Buchanan, Mich. January 31.

Greenfield Tap & Die Corporation, Greenfield, Mass. Fifth award.

Heywood-Wakefield Company, Gardiner, Mass. Fourth award.

Sterling Engine Company, Buffalo, N. Y. Fourth award.

TEXAS COMPANY.—The following changes have been announced in the railway sales division of the Texas Company: *J. M. P. McCraven,* from district manager at Chicago to assistant manager at New York; *John B. Flynn,* from district manager to assistant manager at New York; *A. W. Larsen,* from assistant district manager at St. Louis, Mo., to district manager at Chicago; *C. H. Weisel,* from assistant district manager to district manager at New York; *R. W. Woods,* from representative to assistant district manager at New York; and *W. E. Wilcox,* from lubrication engineer, at Roanoke, Va., to assistant district manager at St. Louis.

◆

OAKITE PRODUCTS, INC.—*Dr. Donald Price* has been appointed Technical Director of Oakite Products, Inc. Dr. Price will direct the activities of Oakite's engineering and chemical staff, including its Research Laboratory and Technical Service Department. He is vice-president of the American Institute of Chemists, councilor of American Chemical Society, member of the Executive Committee, American Branch, American Institute of Chemists and various other professional societies.

◆

UNITED STATES STEEL CORPORATION OF DELAWARE.—*L. M. Parsons,* formerly vice-president and general manager of sales of the Jones and Laughlin Steel Corporation has been appointed assistant to vice-president-sales of the United States Steel Corporation of Delaware with headquarters in Washington. Mr. Parsons was born in Philadelphia, Pa., in 1898. After graduating from the University of Pennsylvania he entered the employ of the Bethlehem Steel Company in 1919 and in 1936 he became district manager of sales at Philadelphia. He became vice-president and general manager of sales of the Jones and Laughlin Steel Corporation in 1938.

◆

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—*Gwilym A. Price* of Pittsburgh, Pa., a vice-president, and *John R. Read* of Hamilton, Ont., chairman and president of the Canadian Westinghouse Company, have been elected directors of the Westinghouse Electric & Maufacturing Company. *L. G. Burwinkel,* assistant to the central district manager, has been appointed assistant to the vice-president and sales manager. Mr. Burwinkel joined the Westinghouse Company in Cincinnati, Ohio in 1924, and served in various accounting and sales positions until 1938 when he was transferred to Pittsburgh, Pa., as central district auditor and district superintendent. He was appointed assistant to the central district manager in 1940.

◆

R. K. LEBLOND MACHINE TOOL COMPANY.—The *Ford Machinery Company* of Toledo, Ohio, has been appointed agent in the Toledo Territory for the R. K. LeBlond Machine Tool Company of Cincinnati, Ohio. The *Calco Machinery Company* Philadelphia, Pa., agent for LeBlond the District of Columbia, Delaware, Maryland, southern New Jersey, and eastern

(Continued on second left-hand page)

34 RAILROADS

improve locomotive performance

by the use of...

SECURITY CIRCULATORS

THESE railroads have installed Security Circulators in their locomotives not only for boiler protection, but to increase locomotive availability and to decrease maintenance.

Security Circulators give these results —

By assuring a positive flow of water over the center of the crown sheet at all times,

By forming an ideal support for arch brick, permitting the use of a 100% arch and promoting better combustion,

By reducing honeycombing, flue plugging and cinder cutting, and by increasing the life of arch brick.

During the last eleven years over fifty-three hundred Security Circulators have been ordered by these railroads.

AMERICAN ARCH COMPANY, INC.

NEW YORK • CHICAGO

SECURITY CIRCULATOR DIVISION

IT'S A GREAT NEW DAY FOR RAILROADING

PAGE CASEY JONES

and find out what he would have thought

about the safety and comfort

of driving a

General Motors locomotive.

GENERAL MOTORS
LOCOMOTIVES

IT'S A GREAT NEW DAY FOR RAILROADING

Full vision ahead and on either side
for a clear view of
tracks and signals—
no steam, smoke or cinders
to obstruct sight.

He might not believe you.
But he could be shown.

ON TO FINAL VICTORY ★ BUY MORE WAR BONDS

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION · LA GRANGE, ILL.

Pennsylvania, has been appointed also to represent the Carlton Machine Tool Company in the same territory. *Nick Koppi*, formerly of the LeBlond sales and service department, has been appointed manager of the Calco Machinery Company.

◆

WILKENING MANUFACTURING COMPANY.—*Helmuth G. Braendel* has been appointed chief engineer of the Wilkening Manufacturing Company, Philadelphia, Pa. For the past three years Mr. Braendel has been assistant and then chief development engineer for the Continental Motors Corporation, Detroit, Mich. Prior to that he was for seven years project engineer in the Engine Development Division of the Chrysler Corporation. He is a graduate of the Stevens Institute of Technology and of the Chrysler Institute of Engineering, with the degree of Master in Mechanical Engineering. Under an International Exchange Fellowship, Mr. Braendel studied advanced mechanical engineering and aeronautical engineering in European universities. He is a member of the Society of Automotive Engineers.

◆

DEARBORN CHEMICAL COMPANY.—*George R. Carr*, chairman of the executive committee of the Dearborn Chemical Company, with headquarters at Chicago, has been elected chairman of the board of directors, succeeding Robert F. Carr, deceased.

◆

JOHNS-MANVILLE SALES CORPORATION.—*Raymond P. Townsend* has been named vice-president of the Johns-Manville Sales Corporation and general sales manager of the company's transportation department. In his new position, Mr. Townsend will assist John H. Trent, vice-president and general manager, in directing sales of the transportation department throughout the United States and Canada.

Mr. Townsend began his career in the purchasing department of the New York Central and later served as purchasing agent of the Liberty Steel Products Company and railroad sales representative of the Murphy Varnish Company. He joined

Raymond P. Townsend

Johns-Manville in 1925 as sales manager of the eastern region and was appointed general sales manager of the transportation department in 1944.

VAPOR CAR HEATING COMPANY.—*A. D. Bruce* has been elected president of the Vapor Car Heating Company, Chicago, to

A. D. Bruce

succeed *W. L. Conwell*, who becomes chairman of the board. *L. H. Gillick* has been elected vice-president in charge of sales and *E. A. Russell*, vice-president in charge of research and engineering.

Walter L. Conwell was born in Covington, Ky., in 1877, and is a graduate of Pennsylvania University. He was employed as chief engineer at the Tennis Construction Company, railway contractors, in 1908-10, and as a salesman of the Westinghouse

W. L. Conwell

Electric & Manufacturing Co. in 1910-11. He was president of the Transportation Utilities Company from 1911 to 1916. He joined the Safety Car Heating & Lighting Company as assistant to the president in 1916 and was elected president of that company in 1919. He was elected president of the Vapor Car Heating Company, Chicago, and the Vapor Car Heating Company of Canada in November, 1928. Mr. Conwell is chairman of the board of the Pintsch Compressing Company, president and director of Safety Refrigeration, Inc., and Products Protection Corporation and a director of Overseas Railways, the Wilcolator Company, and the Carrier Corporation.

Alexander D. Bruce was born in Guelph, Ont., in 1887. His early employment was with a large carriage manufacturing plant and with the Standard Fitting & Valve Co. in Canada. In 1909 he entered the employ of the Chicago Car Heating Company as storekeeper, and was successively purchasing agent and Canadian manager. In 1917, upon the organization of the Vapor Car Heating Company, he was elected its secretary. In 1926, Mr. Bruce was elected a director and vice-president and in November, 1940, executive vice-president.

L. H. Gillick was born at Minneapolis, Minn., on August 25, 1898, and after attending Northwestern University, entered the employ of the Chicago Car Heating Company, predecessor of the Vapor Car Heating Company, in January, 1916. After completing a period of training in the shops he was appointed inspector in the Chicago district. On September 1, 1920, he became Northwest representative of sales and

L. H. Gillick

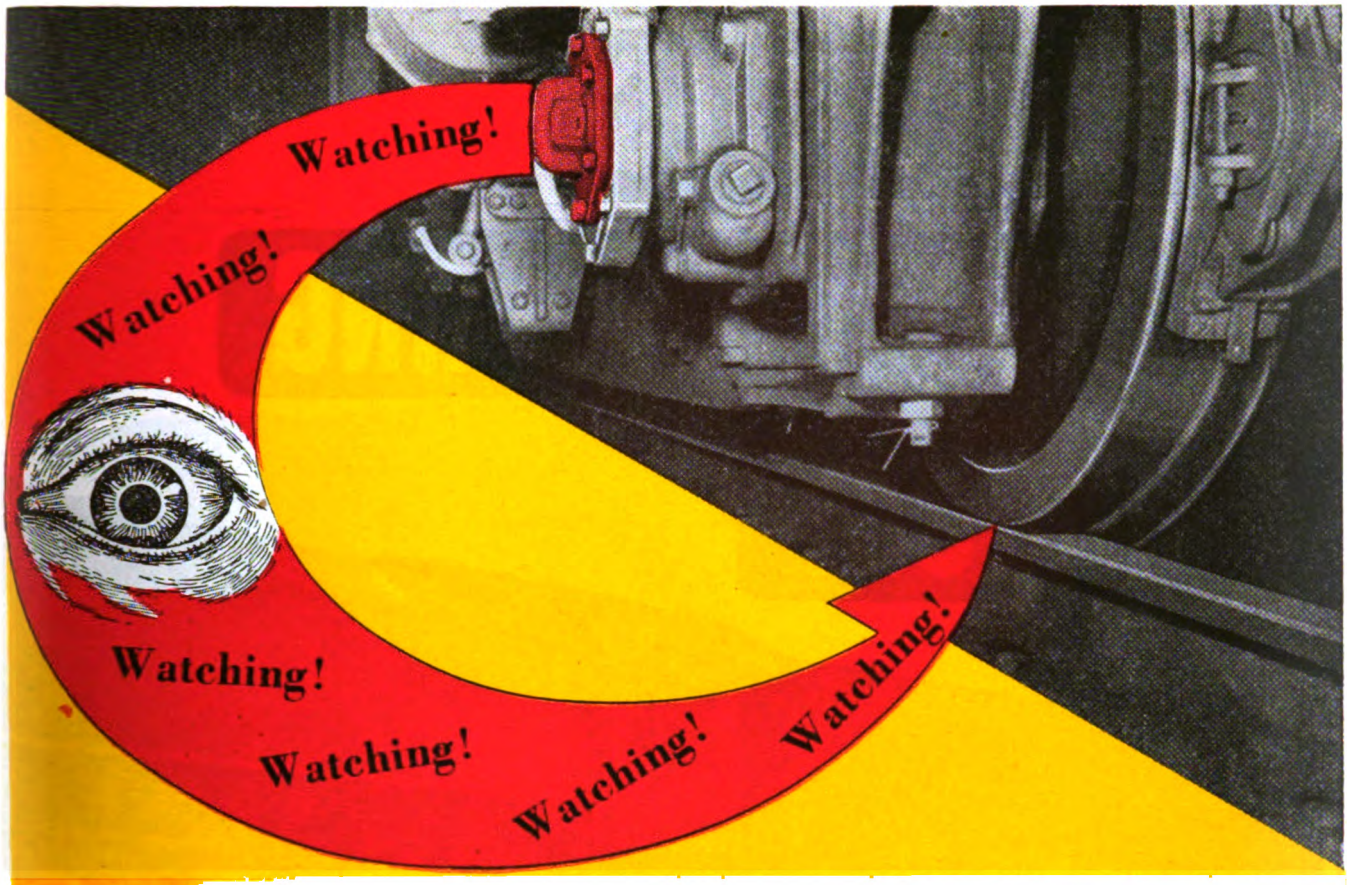
service, with headquarters at St. Paul, Minn. In November, 1925, he was appointed assistant to the vice-president at Chicago, and in November, 1940, sales manager.

Edward A. Russell was born in Pennsylvania in 1887, and attended Crane Manual Training School in Chicago and the Armour Institute of Technology. After seven years on the Pennsylvania Railroad,

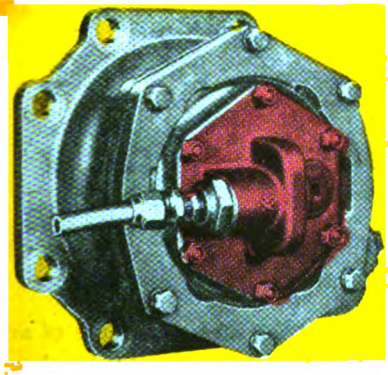
E. A. Russell

beginning as machinist apprentice, he was employed by the Chicago Car Heating Company as a draftsman in 1909. Successively, he has been chief draftsman, design engineer, research engineer, and chief engineer.

(*Turn to second left-hand page*)



On Guard



Softens the Brake When Wheel Slip Impends

THE "AP" Decelostat keeps tab of the wheel whether moving forward or back. It rolls with the wheel and observes the slightest hesitation in wheel rotation when brakes are applied.

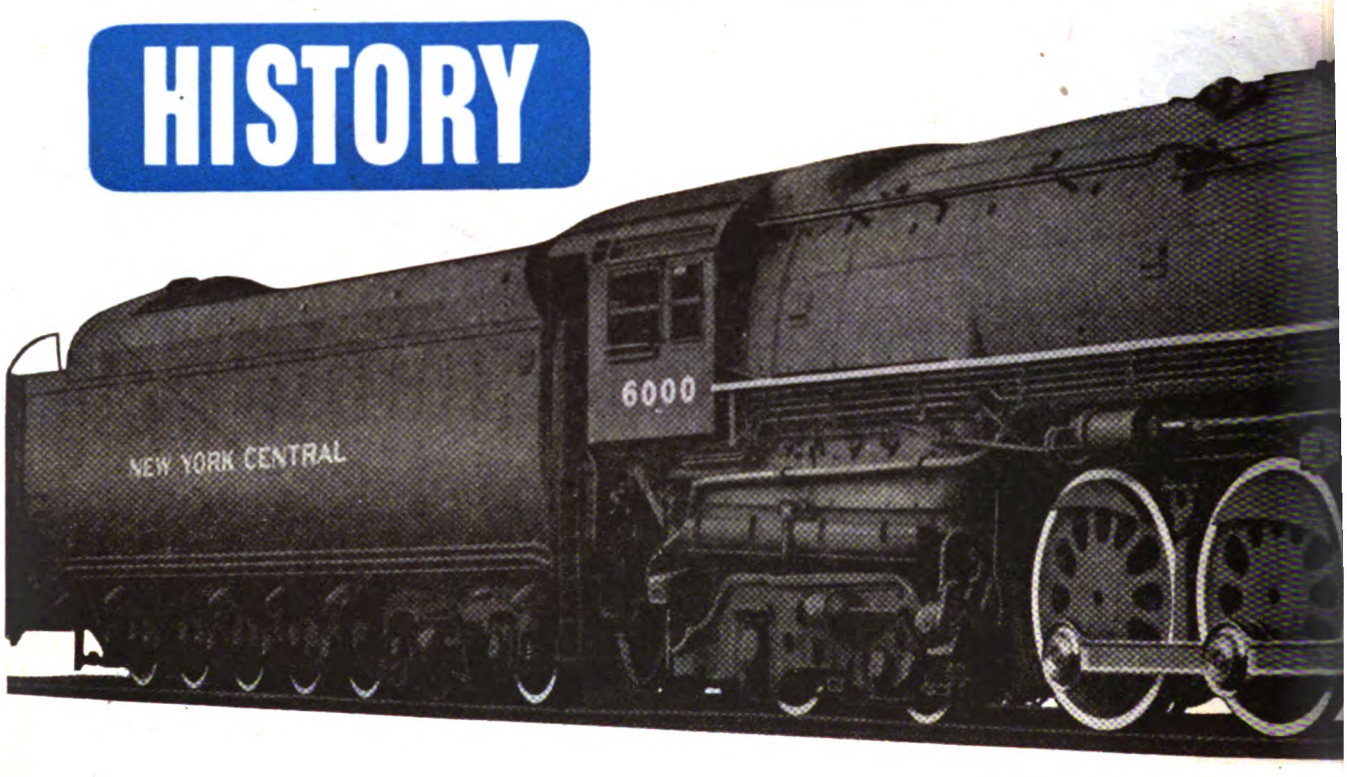
It maintains constant check on the rate of slow-down and is poised to act if this rate reaches a set limit.

And when this limit develops the Decelostat flashes the impulse to the brake cylinders—*softens the brake momentarily*, permitting the offending wheel to get into step with the others in the train.

WESTINGHOUSE AIR BRAKE CO.

WILMERDING, PENNSYLVANIA

LOCOMOTIVES THAT ARE MAKING HISTORY



Gentlemen, meet the new S-1A

PERHAPS you know this locomotive, already. It is of special interest to the entire railroad world.

Why? The answer lies in a problem that is of major importance to management men on practically every American road... *the problem of handling traffic without excessive locomotive investment.*

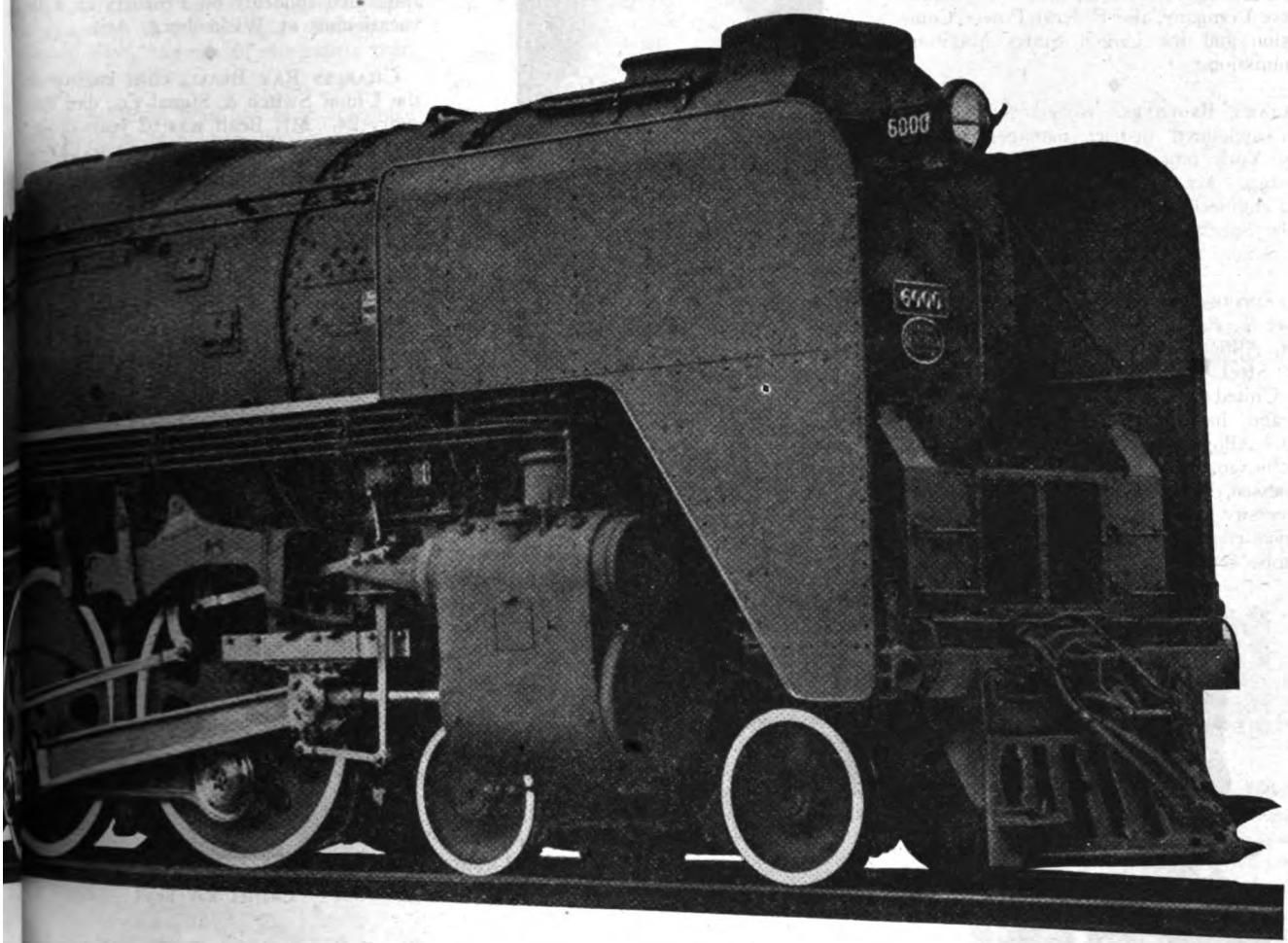
The logical answer to this problem is to provide an efficient *dual-purpose* locomotive—one that can be used effectively both for fast passenger and fast freight hauls.

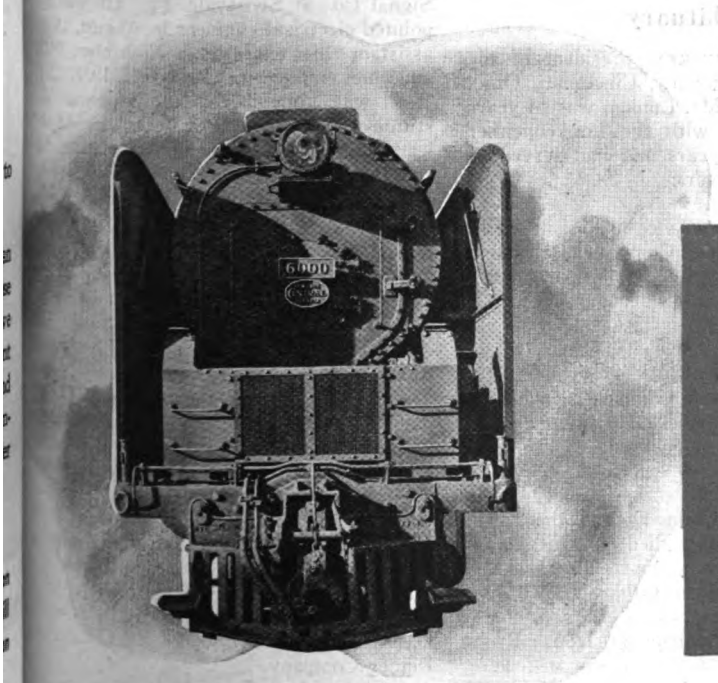
To meet this problem, American Locomotive Company, working with the New York Central System, has developed the locomotive shown above—"The Niagara"—which is designed to combine speed and power.

This locomotive is the latest example of an important development made possible by close cooperation between American Locomotive and The New York Central—a development that helps reduce investment, operation and maintenance costs by reducing the total number of locomotives a railroad needs in order to do its job.

• • •

Locomotive designs developed by American Locomotive Company have been, are, and will continue to be powerful factors in American railroad-operating efficiency and economy.





American Locomotive
NEW YORK

COOPER-BESSEMER CORPORATION.—*Walter F. Myers* has been appointed to the staff of the Washington, D. C., office of the Cooper-Bessemer Corporation to assist *Charles G. Cooper,* director of that office, in the handling and supervision of government contracts and sales and service in the southern Atlantic states. For the past 25 years, Mr. Myers has been employed as sales engineer, construction engineer and consulting engineer for public and private corporations, including the Fairbanks Morse Company, the Federal Power Commission and the United States Maritime Commission.

◆

SCIAKY BROTHERS.—*Robert Santini* has been appointed district manager of the New York office of Sciaky Brothers of Chicago. Mr. Santini was until recently chief engineer delegated by Sciaky Brothers to the Specialty Equipment Company, former Sciaky representative in New York.

◆

CARNEGIE-ILLINOIS STEEL CORPORATION.—*Frank T. Bumbaugh,* assistant manager of sales, Alloy division, of the Carnegie-Illinois Steel Corporation (a subsidiary of the United States Steel Corporation) at Chicago, has been appointed manager of sales, Alloy division, with headquarters at Chicago. Mr. Bumbaugh was born at Monessen, Pa., and is a graduate of Lehigh University. In 1926 he became a metallurgical engineer in the employ of Carnegie-Illinois, serving in the bar, semi-finished

Frank T. Bumbaugh

and alloy products division at Pittsburgh, Pa. In 1942 Mr. Bumbaugh was appointed assistant manager of sales.

◆

INTERNATIONAL NICKEL COMPANY.—*Frederick P. Huston* has been placed in charge of railroad developments in the application of nickel alloy steels, cast irons, Monel and other nickel alloys, development and research division, International Nickel Company. Mr. Huston has been associated with the Inco mill products division since June, 1940, devoting considerable time to the problems of steam locomotive maintenance, particularly boilers and fireboxes. He is a graduate of the University of Missouri (1912) with a degree in electrical engineering. He joined the International Nickel Company in October, 1927, as technical service engineer in the development and research division. He is a member of the general committee of the Metals Engineering Division and of the general committee of the Railroad Division, American Society of Mechanical Engineers, and a member of the staybolt committee of the Master Boiler Makers' Association.

Donald J. Reese, who has been with the

Frederick P. Huston

steel division of the War Production Board at Washington, D. C., since April, 1942, has resumed his duties with the development and research division of the International Nickel Company at New York.

◆

ALLIED RAILWAY EQUIPMENT COMPANY.—*Carl R. Moline,* chief engineer of the Allied Railway Equipment Company, Chicago, has been elected vice-president, with headquarters at Chicago. He will continue as chief engineer.

◆

PITTSBURGH PLATE GLASS COMPANY; PACIFIC ALKALI COMPANY.—The Columbia Chemical Division of the Pittsburgh Plate Glass Company has acquired the Pacific Alkali Company's Bartlett, Cal., plant and Los Angeles, Cal., sales office. A new district sales office has been opened at San Francisco, Cal.

Obituary

ESHELBY F. LUNKEN, president of the Lunkenheimer Company, Cincinnati, Ohio, died January 25. Mr. Lunken was 54 years of age. He was with the Lunkenheimer Company for 35 years and had served as president for 26 years.

◆

W. A. KIRKWOOD, vice-president of the Maryland Car Wheel Company, Baltimore, Md., died February 9. Mr. Kirkwood had been associated with the company for 36 years.

◆

ALBERT SYDNEY BONNER, president of the Clark Equipment Company, Buchanan, Mich., died February 8. He was 53 years of age.

◆

DR. CHARLES F. BURGESS, founder of the Burgess Battery Company and the C. F. Burgess Laboratories died in Chicago on February 13 after a short illness. Mr. Burgess was born in Oshkosh, Wis., on January 5, 1873, and was a graduate of the University of Wisconsin in 1895. From that year until 1900 he was an instructor of electrical engineering and from 1900 to 1913, professor of electro-chemistry and chemical engineering. In 1917 he formed the Burgess Battery Company and served as its president until 1929 when he became chairman of the board.

◆

GARTH G. GILPIN, vice-president in charge of engineering of the Standard Railway Equipment Manufacturing Company, Chicago, with headquarters at Hammond, Ind., died suddenly on February 25, while vacationing at Wickenburg, Ariz.

◆

CHARLES RAY BEALL, chief engineer of the Union Switch & Signal Co., died February 24. Mr. Beall was 62 years of age. He was a graduate of Ohio State University in 1907 with the degrees of electrical engineer and mechanical engineer. He began his career in the engineering apprenticeship course of the Westinghouse Electric & Manufacturing Co. at East Pittsburgh, Pa. After completing the course, he was transferred to the industrial section of the engineering department. In October, 1910, he joined the electrical engineering department of the Union Switch &

Charles Ray Beall

Signal Co., at Swissvale, Pa. He was appointed electrical engineer in August, 1916; assistant chief engineer in November, 1923, and chief engineer on January 1, 1937. Mr. Beall was a member of the American Institute of Electrical Engineers, the American Railway Engineering Association, the Institution of Railway Signal Engineers in England, and the Signal Section of A. A. R.

◆

BERTRAM B. QUILLEN, president of the Cincinnati Planer Company and the Acme Machine Tool Company, died suddenly, February 26, at his home in Cincinnati, O. Mr. Quillen, together with William H. Burtner and George Langen, now vice-president of the Cincinnati Planer Company, founded that company in 1898. Mr. Quillen was born in Lebanon, Ind., August 1, 1869. After receiving his education in the Indiana schools, he entered business in Chicago, but shortly after came to Cincinnati where he began his career in the machine tool industry with Lodge and Davis Machine Tool Company, predecessor of the American Tool Works. Leaving Lodge and Davis, Mr. Quillen founded the Cincinnati Planer Company.

Personal Mention

General

H. W. PINKERTON, electrical and mechanical engineer of the Cleveland Union Terminal at Cleveland, Ohio, has retired after more than 38 years of service.

E. C. RICHARDS, assistant superintendent of equipment of the Michigan Central at Detroit, Mich., has retired after more than 46 years of service.

J. R. FROHOFF, who has been appointed superintendent of motive power and machinery, northwestern district, of the Union Pacific, with headquarters at Albina, Ore., as reported in the March issue, entered the service of the Union Pacific, in August, 1924, as a machinist at Junction City, Kan. In 1928 he became enginehouse foreman at Junction City and later served as general locomotive foreman, mechanical foreman, machine foreman and district foreman at various points. In August, 1938, he was appointed master mechanic at Kansas City, Mo.; in April, 1940, assistant to the superintendent of motive power and machinery at Omaha, Neb., and in August, 1940, master mechanic of the Colorado division, with headquarters at Denver, Colo.

GEORGE G. RITCHIE, who has been on furlough from the Chesapeake & Ohio for the past two years serving as a major in the United States Army, has returned to the C. & O. and has been appointed general fuel service engineer, with headquarters at Richmond, Va.

SAMUEL B. SCHENCK, assistant engineer, motive power of the Bessemer & Lake Erie at Greenville, Pa., has been appointed engineer, motive power. Mr. Schenck was born at Howard, Pa., on May 11, 1891. In

Samuel B. Schenck

1913 he entered the railway engineering department of the Westinghouse Electric & Manufacturing Company, doing electric traction work, and later became a general railway engineer specializing in gasoline and Diesel-electric locomotives and rail cars. During the first world war he served as a second lieutenant of engineers in the office of the director-general of military railways at Washington, D. C. Mr. Schenck entered the service of the Bessemer & Lake Erie in 1934 as special engineer in the mechanical department, working with Diesel locomotives, train communication and on special assignments. He was appointed assistant engineer of motive power on March 1, 1944.

GEORGE H. POLLARD, who has been appointed mechanical engineer of the Missouri Pacific, with headquarters at Palestine, Tex., as reported in the March issue, was born at Moberly, Mo., on July 5, 1894, and was educated at Washington University, Jefferson College, and the North St.

George H. Pollard

Louis Drafting and Engineering School. He entered railway service on June 16, 1920, as a general draftsman in the office of the mechanical engineer of the Missouri Pacific at St. Louis. Later Mr. Pollard became shop draftsman, where he remained until his transfer to Palestine as mechanical engineer.

J. J. DALY, who has been appointed superintendent of motive power and machinery of the Union Pacific, with headquarters at Omaha, Neb., as announced in the March issue, entered the service of the U. P. in 1921 as a machinist apprentice at Laramie, Wyo. He later served in several minor positions at Cheyenne, Wyo., Green River, Ogden, Utah, and Council Bluffs, Iowa, until April, 1942, when he became master mechanic at Council Bluffs. In 1943 he was appointed assistant superintendent of shops at Omaha, and in 1944 was appointed master mechanic of the Nebraska division, with headquarters at Omaha.

Military Awards and Citations

DISTINGUISHED SERVICE MEDAL

BRIG. GEN. CARL R. GRAY, JR., director general, 1st Military Railway Service in Italy and France. For "exceptionally meritorious service to the government in a duty of great responsibility in Italy and southern France." General Gray also holds the Legion of Merit medal and the citation from the Italian Government mentioned on page 141 of the March issue.

ROY C. BEAVER, engineer, motive power, of the Bessemer & Lake Erie at Greenville, Pa., has been appointed superintendent of

Roy C. Beaver

motive power, with headquarters at Greenville. Mr. Beaver was born at Greenville on August 29, 1889, and is a graduate of Thiel College (1913). He entered the service of the B. & L. E. in 1913 as a mechanical draftsman and in 1918, was appointed assistant mechanical engineer. In 1933, he assumed special duties in the car department on the development of lightweight cars; in 1939 became assistant engineer, motive power, and in March, 1944, engineer, motive power.

D. S. NEUHART, superintendent of motive power and machinery of the Union Pacific, at Omaha, Neb., has been appointed assistant general superintendent of motive power and machinery, with headquarters at Omaha. Mr. Neuhart entered railway service in June, 1918, as a coach cleaner in the employ of the U. P., later holding other minor positions until 1921 when he left the company. Two years later he returned as a machinist apprentice at Salt Lake City, Utah, subsequently holding positions at various points on the road including Pocatello, Idaho; Lima, Mont., Cheyenne, Wyo., and Kansas City, Mo. In February, 1937, Mr. Neuhart became superintendent of shops, with headquarters at Los Angeles, Calif.; in April, 1940, master mechanic at Kansas City, and in November, 1941, assistant to the vice-president in charge of research and mechanical standards, with headquarters at Omaha. For a short time he served as master mechanic at Los Angeles, and in August, 1942, was appointed superintendent of motive power and machinery, with headquarters at Omaha.

EDWIN GREY JONES, whose appointment as superintendent of motive power of the Charleston & Western Carolina at Augusta, Ga., was announced in the February issue, was born at Fayetteville, N. C., on March 31, 1902. He is a graduate of the George

(*Continued on second left-hand page*)

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on train communication
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ITC
INDUCTIVE TRAIN COMMUNICATION
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"Union" I.T.C. (Inductive Train Communication) system provides dependable, practicable two-way voice communication between vehicles of a train, between trains, and between trains and wayside points.
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UNION SWITCH & SIGNAL COMPANY

SWISSVALE PENNSYLVANIA

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO

School of Technology and the North Carolina State College of Agriculture and Engineering. He entered railroading in July, 1925, as a special apprentice in the Emerson shops of the Atlantic Coast Line and served subsequently at various points as air-brake machinist from June, 1927, to September, 1929, when he became plant engineer of the Tampa shops at Tampa, Fla. On November 1, 1933, he was appointed assistant mechanical instructor, with headquarters at Waycross, Ga., where he became gang foreman in September, 1938. One year later he returned to Tampa as assistant foreman in the locomotive department; in March, 1941, became erecting shop foreman and in July, 1942, general foreman of the Tampa shops.

EDWARD C. KAISER, general foreman of the Reading at Philadelphia, Pa., has been appointed superintedent of motive power of the Lehigh & New England, with headquarters at Pen Argyl, Pa.

R. R. SNEDDON, assistant to the superintendent of equipment of the Michigan Central at Detroit, Mich., has been appointed assistant superintendent of equipment, with headquarters at Detroit.

Master Mechanics and Road Foremen

H. F. DERRY has been appointed road foreman of engines, West End, Baltimore division, of the Baltimore & Ohio, with headquarters at Baltimore, Md.

K. A. LENTZ, master mechanic of the Southern at Somerset, Ky., has been transferred to Birmingham, Ala.

W. G. MCCONACHIE, master mechanic of the Canadian National at Edmonton, Alta., has retired.

JAMES E. GOGERTY, general locomotive foreman of the Union Pacific at Cheyenne, Wyo., has been appointed master mechanic, with headquarters at Denver, Col.

OSCAR J. ROBINSON, assistant master mechanic of the Union Pacific at Council Bluffs, Iowa, has been appointed master mechanic at that point.

E. N. STEWART, acting master mechanic of the Smithers division of the Canadian National at Prince George, B. C., has been appointed master mechanic, with headquarters at Prince George.

F. T. WALDEN, master mechanic of the Southern at Birmingham, Ala., has been granted a leave of absence because of illness.

H. E. NIKSCH, division master mechanic of the Chicago, Milwaukee, St. Paul & Pacific, at LaCrosse, Wis., has been transferred to the position of division master mechanic at Chicago.

DAVID BEATH, acting master mechanic of the Canadian Pacific at Moose Jaw, Sask., has been appointed master mechanic of the Saskatchewan district, with headquarters at Moose Jaw.

S. H. DUBOSE, master mechanic of the Southern at Ludlow, Ky., has been transferred to the position of master mechanic at Somerset, Ky.

GEORGE C. SHUGARS, formerly an engine house foreman of the Reading, has been appointed master mechanic of the Reading division.

Obituary

A. T. PFEIFFER, road foreman of engines of the New York Central at Syracuse, N. Y., died on February 20. Mr. Pfeiffer was president of the Traveling Engineers' Association when that association amalgamated with the International Railway Fuel Association in 1936. At the time of his death he was a member of the Advisory Committee of the combined associations, the Railway Fuel and Traveling Engineers' Association.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

WELDING RODS.—Eutectic Welding Alloys Company, 40 Worth street, New York 13. Six-page folder on Eutectic low temperature rods which can be used with any oxyacetylene or electric-arc process for welding on cast iron, malleable iron, steel, copper alloys, nickel alloys, aluminum alloys, magnesium, tungsten carbides, etc.

BATTERIES FOR DIESEL LOCOMOTIVES.—Gould Storage Battery Corporation, Depew, N. Y. Catalog No. 700, "Gould Cathanode Glassklad Batteries for Diesel Locomotive Service." 20-page booklet gives pertinent facts on the application of storage batteries in Diesel locomotive service. Includes also a section on the basic principles of the lead acid battery and another on the care and maintenance.

◆

HYDRAULIC CYLINDERS.—John S. Barnes Corporation, Rockford, Ill. Bulletin 401C describes Barnes line of hydraulic cylinders manufactured in conjunction with Barnes hydraulic pumps, valves, and self-contained hydraulic power units.

◆

CLARK PRODUCTS.—Clark Equipment Company, Buchanan, Mich. Miniature 32-page booklet, in color, illustrates and briefly describes Clark Celfor drills and reamers, electric steel castings, metal spoke wheels, front and rear axles for trucks and buses, transmissions, gears and forgings, fork trucks and industrial tractors, railway car trucks, etc.

◆

MASTS AND TOWERS—The Harco Steel Construction Co., Elizabeth, N. J. Illustrated catalog describing masts and towers available for radio antennae, mounting of lights, etc. Units vary from 20 to 500 ft. in height and are characterized by being easy to erect. Types include guyed and self-supporting, square, triangular and tapered towers.

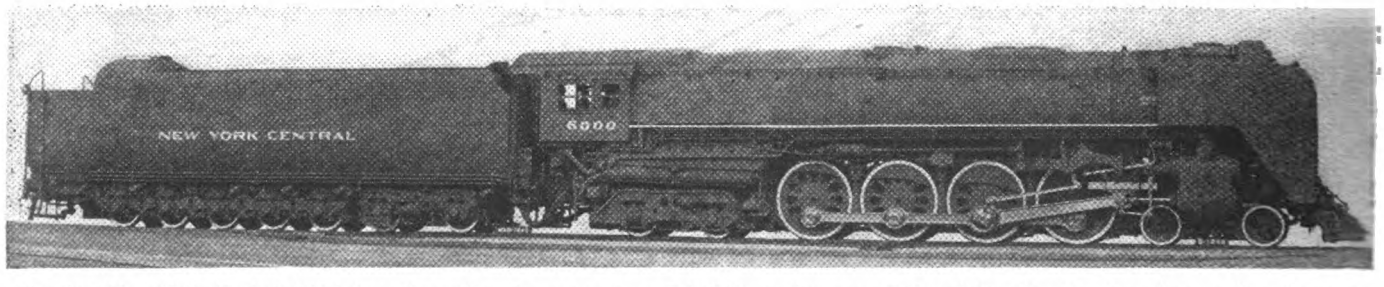
◆

CORROSION.—The International Nickel Company, 67 Wall Street, New York 5. 54-page pamphlet—a comprehensive analysis of corrosion principles both for the practical man and the technician in the metal field. Explains how corrosion processes work and discusses known factors that influence their action. Analyzes applicability of Monel, nickel and Inconel in various corrosive media; lists typical corrosives in which these alloys have been successfully used, and reports the results of more than 120 specific tests under varied conditions in 44 common corrosive agents.

◆

TURRET LATHE.—The Warner & Swasey Company, Cleveland 3, Ohio. Fourteen page illustrated pamphlet descriptive of the new No. 5 Universal turret lathe, twelve-speed all-geared head, with surface speed preselector.

* * *



The first New York Central 4-8-4 type locomotive for passenger and freight service was delivered by the American Locomotive Company on March 10—The locomotive, known as Class S-1, has a larger boiler than the Class L-4 4-8-2 freight and passenger type—It will be tested with both 75-in. and 79-in. driving wheels—The 25 additional locomotives on order will have 29-in. wheels.

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Railway Mechanical Engineer

May 1945

MAY 8 1945

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RAILWAY MECHANICAL ENGINEER

(Name Registered, U. S. Patent Office)
With which is incorporated the RAILWAY ELECTRICAL ENGINEER.

Founded in 1832 as the American Rail-Road Journal

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MAY, 1945

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BYERS Staybolt Iron

points a way to cut maintenance costs and increase operating time on steam locomotives

Two of the main aims of every railroad mechanical department are increasing locomotive availability and decreasing maintenance costs. Byers Staybolt Iron has some special qualities and properties that can help you to realize these ambitions.

The method of manufacture produces remarkable uniformity; analysis and properties structure are duplicated to narrow limits. All material is twice piled, and normal specifications are exceeded in that all slabs on *both* pilings run the full length of the pile. The total reduction in section from original bloom to staybolt blank is over 57,000 to 1. This results in a more uniform slag distribution than is obtainable by any other means.

The blanks are unusually true to size, round and straightness, so there is no difficulty in getting full, sharp threads.

Wrought iron staybolts have proven their ability to stand up under high boiler pressure . . . to resist live fire and elevated temperatures in the firebox . . . to withstand vibration, shock and rapid heating and cooling. A. M. Byers Company is working continuously to keep Byers Staybolt Iron equal to every need.

Byers Staybolt Iron conforms to all requirements of AAR and ASTM specifications, and is available through your staybolt manufacturer, or for use in your own shops. Incidentally, we have prepared a wall chart which shows the piling and reduction pattern followed in producing Byers Staybolt Iron. We will be glad to send you a copy on request.

A. M. Byers Co., Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.

FORGING BILLETS. The same unusually high quality and uniformity found in Byers Staybolt Iron is duplicated in Byers Forging Billets—also at a material saving. They are produced in round, square or rectangular sections, under ASTM-A-73 and AAR-M-307 Specifications.

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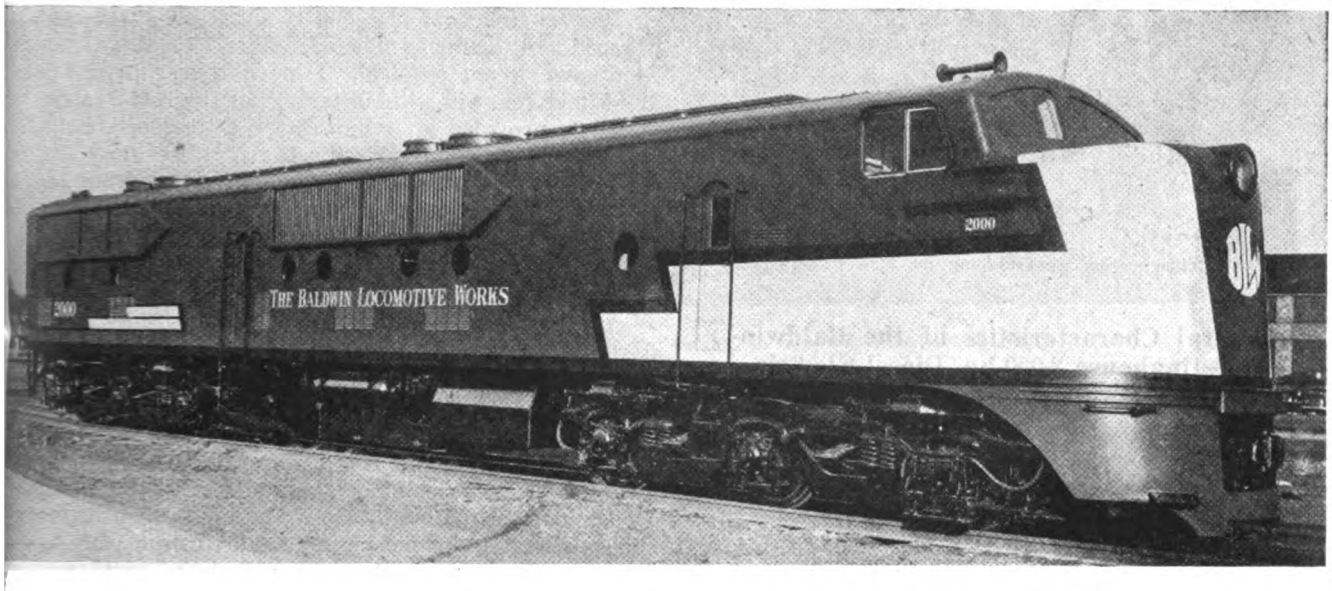
ELECTRIC FURNACE ALLOY STEELS · OPEN HEARTH ALLOY STEELS
CARBON STEEL TUBULAR PRODUCTS



Baldwin-Westinghouse Builds

4,000-Hp. Road Diesel

Locomotive consists of two A units, each powered by two Baldwin eight-cylinder, four-cycle Diesel engines

For the past several months The Baldwin Locomotive Works has been making road tests on a Baldwin-Westinghouse Diesel-electric road locomotive designed for high-speed service. The locomotive consists of A units of 2,000 hp. each, equipped for head-end service. The power plants consist of 1,000-hp. eight-cylinder four-cycle Baldwin Diesel engines, direct connected to Westinghouse generators. The traction motors and control equipment are also supplied by the Westinghouse Electric & Manufacturing Company. The total weight of the A unit is 380,000 lb. and it is carried on two six-wheel trucks. The starting tractive force, at 30 per cent adhesion, is 76,200 lb. The length of the A unit, inside coupler knuckles, is 80 ft.; truck centers are 49 ft.

Arrangement of Equipment

The two 1,000-hp. power plants are located on the center line of the locomotive. The air compressors are located at the rear end of each engine. The air reservoirs and intercooler are mounted underneath the underframe. The blowers for cooling the traction motors are V-belt driven from the engine crank shaft and are located at the forward end of the front engine and at the after end of the rear engine. The fuel and water tanks are suspended beneath the underframe. Motor-driven fans, taking current from the main generators, draw the air for the engine cooling system through shutters in the cab sides, thence through the engine radiators and discharge it through openings in the roof. Radiator shutters and fan motors are thermostatically controlled.

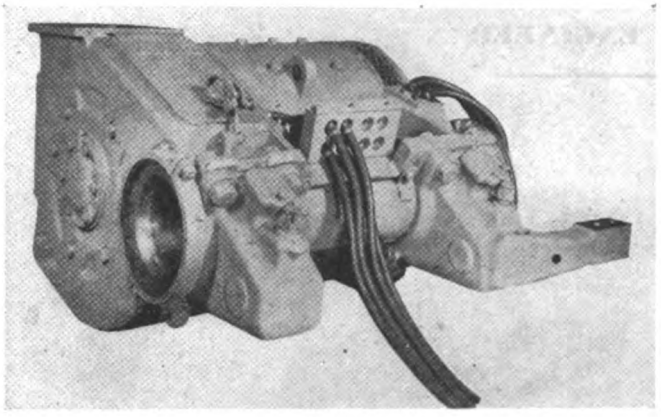
The engineman's operating compartment is arranged at the forward end of the A unit and at the opposite end of the unit is the steam generator and crew toilet facilities.

Underframe and Cab

The underframe of the locomotive is a welded fabricated structure of steel plates and shapes. The principal longitudinal and transverse members are of I section. The superstructure framing is of the truss type and the cab sheets are welded to the framing.

The operator's cab has fixed front windows with combination hinged and sliding side windows. All windows have shatterproof glass. Windshield wipers, defrosters and sun visors are fitted to the front windows. The operator's cab is double sheathed with insulation between the cab sheets. The two doors leading into the engine compartment are metal, with small shatterproof glass ports in the upper part. The cab is heated by steam radiators.

Cab equipment consists of upholstered, adjustable



The traction motors are axle-hung and blower-ventilated

General Characteristics of the Baldwin-Westinghouse 2,000-hp. Diesel-Electric Locomotive (A Unit)

Diesel engines, two, eight cylinders (in line), 1,000 hp. each	**2,000**
Traction motors:	
Number	**Four**
Maximum speed restriction, m.p.h.	**90**
Gear ratio	**21:58**
Wheels:	
Driving, pairs	**Four**
Idling, pairs	**Two**
Diameter, in.	**40**
Weight in working order, total, lb.	**380,000**
Wheelbase, ft.-in.:	
Each truck, rigid	**15-4**
Total locomotive	**64-4**
Maximum overall locomotive dimensions, ft.-in.:	
Height	**14-9**
Width	**10-6**
Length, inside knuckles	**80-0**
Tractive force, lb.:	
Starting, at 30 per cent adhesion	**76,200**
Continuous at 21.5 m.p.h.	**28,500**
Minimum radius curvature, locomotive with train, ft.	**359**
Fuel oil, gals.	**1,200**
Lubricating oil, gals.	**220**
Engine cooling water, gals.	**580**
Heating boiler water, gals.	**1,200**
Sand, cu. ft.	**30**

seats, right and left. On the right side are the engine controls, brake equipment, air gauges, speedometer, wheel slip indicator, train signal, light, bell, horn, defroster and sander controls. The train control signal light box is mounted in the center. The boiler and ground indicating lamps, water and fuel oil gauges and hand brake are located on the left side.

The engine compartment is sheet steel substantially braced with carlines. The roof is steel plate with hatches for power plant removal. Hinged covers permit piston and liner removal without taking off the main hatches. A hatch is provided for removal of the steam generator.

The engine compartment has two side doors and one at the rear leading to the vestibule. Handrails are installed where necessary in the interior of the engine compartment. The exterior handrails, steps and safety appliances comply with I. C. C. regulations.

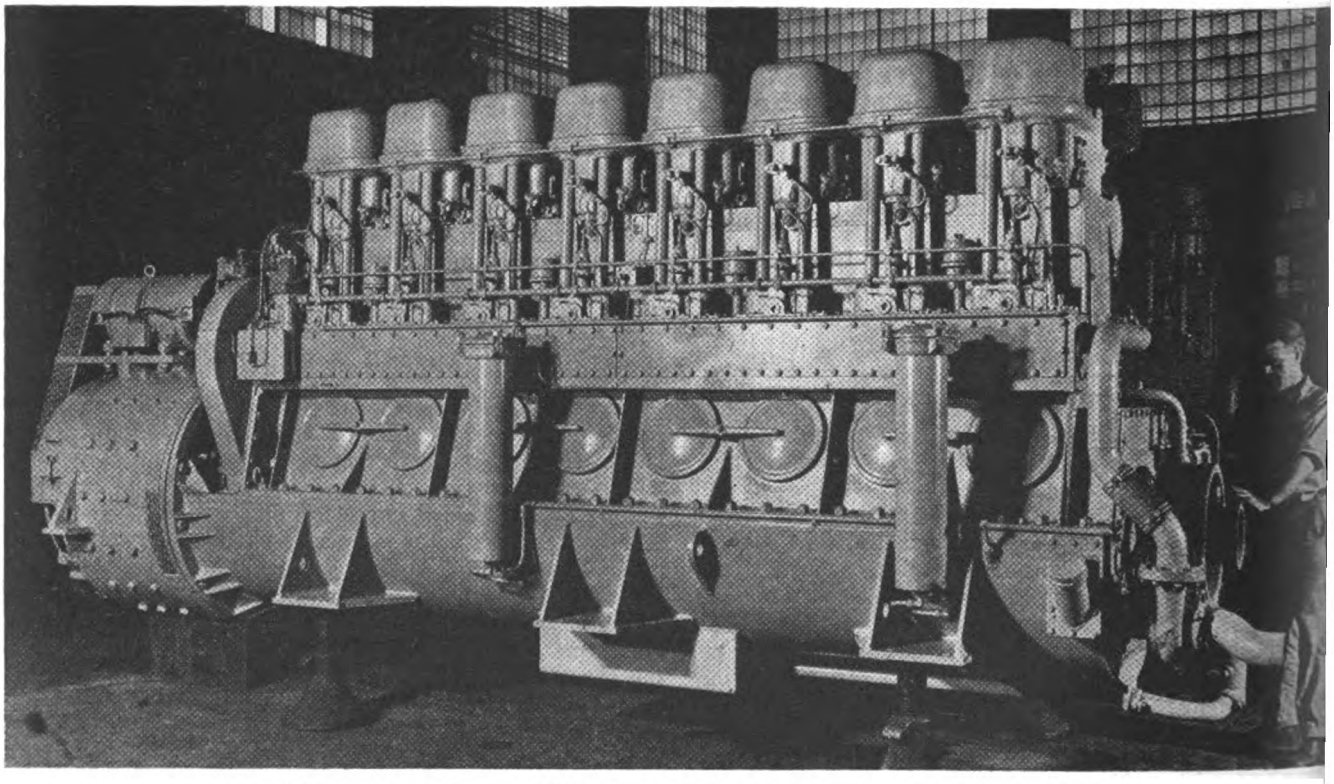
The Diesel Engines

The Diesel engines are the Baldwin eight-cylinder (in line) four-cycle type developing their rated power at 625 r.p.m. The cylinders are 12¾-in. bore and 15½-in. stroke.

The bed and engine frame are weldments of steel. The frame houses the cylinder liners and is integral with the upper part of the crankcase. The liners are the removable sleeve type of nickel cast iron, chrome plate on the wearing surface. The crankshaft is a solid forging drilled for lubrication, with 8¾-in. main bearing journals and 8⅜-in. crank pins. Main bearings are removable without lifting the crank shaft.

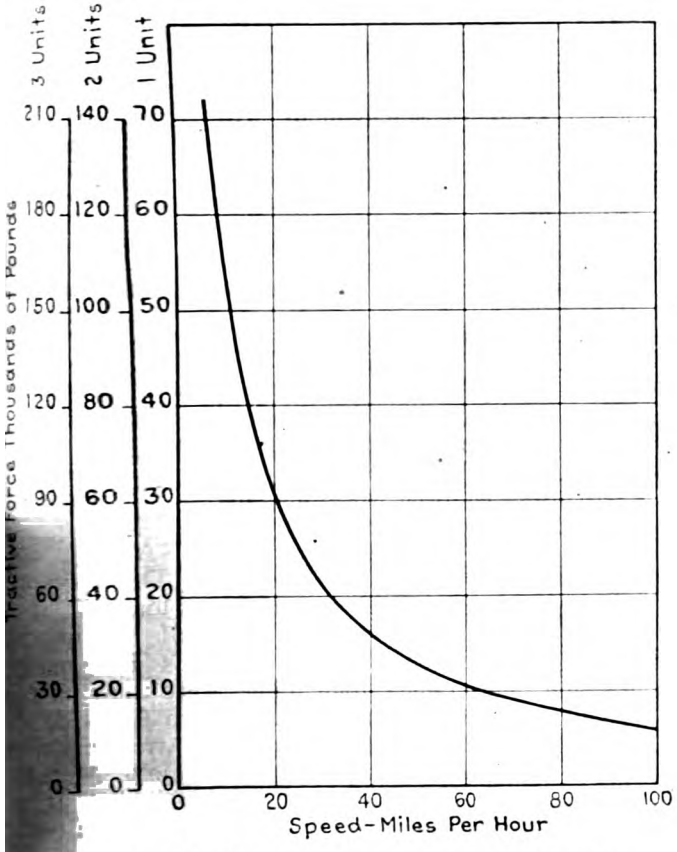
The cylinder heads, embodying the turbulence combustion chamber, are separate castings. The pistons are heat treated aluminum alloy with five compression rings and three oil control rings.

The camshaft is chain driven from the generator end of the engine. The governor, fuel pump, fuel nozzle and lubricating oil filter are on the cam shaft side of the engine. The air intake header and filter, exhaust mani-



The 1,000-hp. power-plant assembly includes engine, main and auxiliary generators and exciter

The traction motors are geared to the outside axles of the six-wheel trucks



Speed-tractive force curve for single and multiple units

fold, muffler, fuel oil filters and transfer pump are on the opposite side.

The valves are alloy steel, located in the heads and actuated by rocker arms. The fuel injection system is the unit injector type with injection pumps at each cylinder. Engine speed is controlled by the governor. An independent overspeed stop is also provided.

Lubrication is by means of pressure pump chain driven from the crank shaft. The oil supply is contained in the bed plate sub-base.

Engine cooling is effected by means of a chain-driven centrifugal water pump which circulates the jacket water through radiators which also have a section for cooling the lubricating oil. Each engine has a radiator assembly located under the compartment roof. Thermostatically controlled shutters are installed in the engine compartment side walls back of which are the oil and water radiators. There are two independent radiator piping systems, one for each engine; included in which is an expansion tank with pipe connection for filling, draining and stand-by heating.

Electrical Equipment

Two Westinghouse Type 480-B generators furnish power to the four traction motors, one generator supplying power to Motors No. 1 and 2 which are connected permanently in series and the other supplying power to Motors No. 3 and 4. The generator frame is supported

(*Continued on page 200*)

The underframe and superstructure framing are welded sections—The steel cab sheets are welded to the framing

Proper Loading of Freight Cars*

By A. H Keys†

Safe movement of freight requires full compliance with loading rules — Cooperation of the shippers with carriers now at the highest point ever

DELIVERING the commodities which have been entrusted to the railroads, care quickly and safely to their destination calls for careful observance of the A.A.R. Loading Rules and the supplements thereto. These rules are issued annually and supplemented periodically after careful investigation by tests of suggested loading methods and practices made by practical railroad men who are assisted by and greatly aided through the cooperation of the shippers.

The average shipper, while anxious to load and brace his shipment as adequately as possible, is further interested in having the shipment delivered to its destination as quickly as possible and without damage. He will comply with any bracing or blocking requirement if he is convinced that such bracing and blocking is necessary to insure the safe transportation of his product.

Shippers frequently suggest methods of loading their products where no loading rule has been provided and, in some cases, they even suggest alternate methods to those published in the A.A.R. Loading Rules. These suggestions are referred to the Secretary of the Mechanical Division Association of American Railroads, in accordance with paragraph 4 of the preface to the loading rules, after which they are referred to the chairman of the Committee on Loading Rules and investigated by the various sub-committees dealing with particular products. Investigation by a sub-committee, including the conducting of shock tests, usually results in an authorization for the movement of sufficient trial shipments to assure that the loads are properly and safely secured before the new method is published in the rules. Shippers have cooperated whole-heartedly with the Association of American Railroads by working with the Loading Rules Committee, suggesting new methods of loading and conducting shock tests in their plants. Their efforts and suggestions have resulted in many new methods being devised which have been mutually beneficial to all; the shipper, the customer and the carrier. A splendid spirit of friendly feeling has been created between the railroads and the shippers.

The various car department organizations, including the Eastern Car Foreman's Association, cannot be too highly commended for the active part they have played in cooperating with the shippers in solving their loading problems, and these associations have greatly aided the Committee on Loading Rules, directing their attention to cases where added securement was deemed necessary to eliminate transportation hazards and provide for the safe transportation of a particular commodity.

The activities of the various mechanical committees, appointed by the Executive Vice-Chairman of the Association of American Railroads primarily to police the inspection of cars placed for loading to assure that the equipment was in suitable condition to carry a load and was free from defects which would delay movement to destination, have also been a valuable asset to the Committee on Loading Rules. They have aided in the enforcement of the present rules and pointed out the need for new figures and new specifications for many of the new commodities which the railroads have been called upon to handle. They have also been instrumental in aiding in the elimination of sharp practices formerly resorted to by some of the shippers as well as by some of the railroads.

While we, as individual railroad men, have a natural inclination to secure a maximum share of the nation's traffic on our railroad, we must see to it that no shipments are accepted from a shipper unless they are properly loaded and braced in strict accordance with the minimum requirements of the A.A.R. Loading Rules.

Rules Governing War Materials Loading

The American railroads are better fitted now than ever before for loading any shipment which might be offered for movement by rail, whether these shipments are for civilian consumption, or are ordnance, military vehicles or other war-time shipments. The manner in which these complete rules were brought about, is expressed in a part of an editorial which appeared in the Railway Age, for March 3, 1945,

"Late in 1940 representatives of the A.A.R. approached officials of the War and Navy Departments and suggested that the preparation of loading specifications to cover the various units of equipment which might be offered to the railroads for movement would be desirable. Joint studies were then undertaken and a supplement to the rules issued in April, 1941. This was distributed to all railroads and Army installations and made a part of the Officers' Field Manual. Later changes have been similarly handled. It is interesting in this connection to note that the railroads initiated this work more than a year prior to our entrance into the war and issued the first instructions about six months before Pearl Harbor. * * *

"Probably no honor will be paid to any of the members of the committee but they can have the satisfaction of knowing that theirs was a job well done which certainly has contributed much to eventual victory. The uninterrupted flow of properly loaded cars to all of our ports is proof of that."

Members of the Armed forces were trained in the loading and bracing of open-top cars in accordance with these rules, with the result that military vehicles were transported in complete trains accompanied by the military personnel direct from the Army installations to ports of embarkation without delay.

Subsequently, it was deemed advisable to issue what is now known as special supplement No. 2 containing

* A paper delivered before the Eastern Car Foreman's Association at New York on April 13, 1945.

† Assistant superintendent car department, Baltimore & Ohio, Baltimore, Md.

rules governing the loading of standard military vehicles not transported in complete trains and not accompanied by or under the direct supervision of military personnel. This supplement was issued to the Army installations, the railroads, and the various manufacturing plants, and has proved invaluable in expediting the shipments moved in regular freight trains to ports of embarkation or to the arsenals where the material is tested or accumulated for further movement to the battle fronts.

The movement of materials of war from arsenals and the various manufacturing plants throughout our country to the ports of embarkation for the loading of a single convoy required a total of 24,483 freight cars. Collecting this material—bringing it hundreds, even thousands of miles—delivering it to shipside on schedule and in pre-arranged order,—doing this day after day, is one of the biggest and most responsible jobs that the railroads have to do. It could not be accomplished without the magnificent cooperation of the shippers, the Navy, the Army, as well as of the port authorities. Yet in back of it all is the railroad car inspector whose duty it is to see that the cars selected to carry these shipments are of sufficient capacity, that the floor is free from defects which would permit the lading to break through or which due to deterioration would not hold the bracing necessary to secure the loads, and that the running gear, the sills and the superstructure of the car itself are in such condition that the car will continue through to destination without delay. After a load is placed on or in a car, the car inspector must see that it is equally distributed so that one truck does not carry in excess of one-half of the load weight stencilled on the car and that the weight along both sides of the car is about equal for the entire length of the load; that loads placed between truck centers do not exceed the weight limitations over specified spaces shown in the table published in General Rule 4, and that all of the requirements for blocking and securing of the loads, as specified under the individual figure, are applied.

The rules governing the loading of commodities on open-top cars are mandatory. No deviation is permitted as the securements shown under the individual figures are minimum requirements based on many years of exacting studies and experimental shipments. It is, however, impossible to provide a specific rule for each and every type of lading. Therefore, where no definite rule has been provided, the securement of the load should conform as nearly as possible to the best example that can be chosen from these rules.

Loading Rules 1 to 39, inclusive, are issued by the Operating-Transportation Division of the Association of American Railroads in pamphlet form and govern the loading, bracing and blocking of commodities loaded in closed cars.

The general rules published in the fore-part of each of these pamphlets are mandatory and, much like the general rules of the open-top code, cover the placement of the lading in the car and the securement required to prevent displacement in transit. Careful observation of these rules is necessary to prevent damage to the shipments and hazards on the railroads. For example, lading may shift sideways in transit, causing derailments, or a concentration of weight may subject the floors of the cars to excessive stresses causing them to break and the lading to fall through.

Munitions Loading

The loading of small arms ammunition, shells of all calibers for the Army and Navy, and bombs of various sizes, are generally handled in closed cars. The loading of such material, while generally performed by the various manufacturers throughout the country, is under the direct supervision of the Army Ordnance Departments. When the conversion of many pre-war industries to the manufacture of these materials was made, the task of instructing the various shippers with regard to placement and securement of the loads became a problem with which many individual railroads were confronted. In many cases railroad car inspectors were prohibited from entering plants to inspect the loading before cars were sealed. However, with the cooperation of the various ordnance offices, as well as of the plant production managers, arrangements were made to admit the car inspectors to these plants. Assistance and suggestions were also rendered by the various steel strapping and wire companies and little difficulty was experienced after standard rules were set up for the loading of these materials. Pamphlet No. 27 depicts the methods of blocking and bracing the shipments and specifies the size and number of metal straps or wires required to brace these shipments properly. These specifications, like those in the open-top rules, were adopted only after extensive study and experiment.

An outstanding case involved shipments of 500-lb. bombs for the Pacific coast. I was informed by an ordnance office that after 27 carloads of bombs, loaded in strict accordance with the rules, had arrived at destination in perfect condition, six subsequent shipments arrived at destination badly disarranged and damaged. An inspection was made of several cars being loaded at this particular plant and it was found that its stock of 1¼-in. by 0.35-in. high-tension bands, having a load strength of 4,000 lb., had been consumed. The loading foreman had substituted ¾-in. by .035-in. high-tension bands, having a load strength of only 2,500 lb. They did not have sufficient tensile strength and failed in transit. A supply of 1¼-in. bands was procured immediately and no further trouble was experienced at this plant.

Before our entry into the war, to cite another instance of railroad-shipper cooperation, the American railroads were called upon to handle many shipments originating north of the Canadian border for movement to our eastern seaboard for export. Among these shipments were thousands of crated motor trucks and tanks loaded on flat cars and in gondola cars. These crates were placed one on the other to reach the maximum railroad clearance height and it was found that the excessive weight of the crates in the top tier caused a crushing of the boxes loaded on the floor of the car, thereby creating a very hazardous condition. Correspondence with the shipper would have entailed considerable delay, and to expedite the correction of this trouble, representatives of the Loading Rules Committee called on the shipper in Canada where they were courteously received and were allowed to inspect loads being prepared for shipment. This inspection included the crating department where the crates were pre-fabricated before being loaded. A slight alteration in the construction of the crate was suggested. However, the shipper informed the committee that it was not possible to change the construction of any part of the crate, but did express willingness to go to any reasonable expense to place external bracing on the crates after they were loaded on the car. The suggestion was adopted and resulted in the elimination of further trouble with these shipments.

Subsequent investigation developed that the crates used for these shipments were manufactured in compliance with specifications furnished by the British Ministry of War and their construction served two purposes.

The crates were disassembled after arrival at the battle front and the sides, ends, tops and bottoms then were reused without alteration for the construction of barracks, hangers and ammunition dumps.

Deterioration of Freight Cars

The revenue tonnage originating on the lines of the Class I railways has materially increased since Pearl Harbor. Prior to the order of the Office of Defense Transportation that freight cars be loaded to their maximum stencilled load-limit capacity, freight cars were usually loaded only to the minimum-pay-load tonnage. To further emphasize this point, let us consider a 140,000-lb. capacity gondola car with a stenciled load-limit capacity of 158,000 lb. A few years ago this equipment was loaded with an average of 50,000 lb. of steel. Today this same equipment carries an average of 150,000 lb. of steel; usually within a few pounds of the stencilled load-limit capacity, which you will note, represents a 300 per cent increased tonnage per car. Placing this increased tonnage in a car meant that the height of the piles had to be materially increased. With the height and the weight of the pile increased by 300 per cent or more, the number of metal ties used to hold the piles together had to be increased, as experience proved the existing bracing and tieing methods were inadequate to withstand the side pressure encountered in moving these loads across the continent. The shippers of steel products, while not objecting to strengthening the methods then being used, requested proof of the necessity for increased securement for their loads.

The Association of American Railroads, with the cooperation of one of the western carriers, invited representatives of the American Iron and Steel Institute to accompany a sub-committee of the A.A.R. Loading Rules Committee to a mid-western interchange for the purpose of inspecting all of the loads being handled through that interchange. This inspection developed that, while some increased securement was necessary, the principal cause of disarrangement of the loads was failure on the part of the shipper to comply with the provisions of the A.A.R. Loading Rules. There was a further failure on the part of the railroads who accepted these loads from the shippers to take exceptions to the manner in which they were loaded.

As a result of this investigation the Loading Rules Committee revised certain rules which wese found to be inadequate due to the increased tonnage being placed in the cars. Representatives of the shippers pointed out to their loading personnel the need for greater care in compliance with the loading rules and the need for the increased securements which was being provided. This case indicates the close harmony and the spirit of cooperation which exists between the shippers and the A.A.R. Loading Rules Committee.

While I have pointed out the necessity for increased securement due to the increased height and weight of such loads, let us consider, from a car-construction standpoint, the increased stress placed upon the body bolsters, the diaphragms, the floor supports, as well as the center and side sills of this equipment.

Although freight cars were constructed originally to meet A.A.R. specifications, deterioration has taken place with age. A car with corroded body bolsters and center sills or brash and decayed flooring cannot reasonably be expected to carry the same load as a newly constructed car unless certain reinforcements have been provided to compensate for the deteriorated conditions. The car owners have been called upon by the Association of American Railroads to withdraw such equipment when it is in such deteriorated condition that it is unsuitable to carry the maximum tonnage until it has been shopped, repaired and suitably reinforced to carry its stencilled load-limit capacity. Where the car owner has determined that the car is unsuitable to carry the maximum load weight, or where the percentages of the stencilled load-weight limits, as shown in the table accompanying General Rule 4 of the A.A.R. Loading Rules, cannot be safely carried, the car owner must, by stencilling on the car and by publication in the Official Railway Equipment Register, indicate that the carrying capacity of the car has been reduced.

It is the duty of the car inspector, when selecting cars for loading, to exercise care and judgment with respect to the physical condition of the car, taking into consideration the weight of the load and the distance which it is to travel. Let us consider a shipper who is going to load five carloads of heavy materials; two of them destined to the west coast, two of them to a nearby city, and the other one for local delivery. Assume that several of these cars have been rebuilt recently and the other cars, while free from actual sill or body bolster failures, have not been conditioned in the shop for a number of years. The car inspector should suggest to the shipper that the cars in the best physical condition be the ones in which the loads are placed that are destined to the west coast, or the longest haul shipments. This plan has been followed successfully by many of the larger steel shippers.

Cooperative Efforts Succeed

The efforts and the cooperation of the various Army Ordnance Departments with the Operating-Transportation Loading Rules Committee in the preparation of adequate rules governing the loading of such commodities in closed cars have meant that the railroads have experienced few cases of failure in the handling of empty and loaded projectiles, bombs, and other high explosive materials which are being transported daily to our ports of embarkation. However, neither the Loading Rules Committee nor the Ordnance Departments can always be sure that their instructions are complied with. This is the job of the car inspector whose responsibility it is to see that in addition to suitable cars being furnished, the requirements of the loading rules for placing materials in the cars and the bracing of such materials is done in strict accordance with these rules.

The Loading Rules Committee can determine the minimum requirements for the loading and bracing of shipments and publish definite and readily understandable rules for the guidance of the shippers and for the railroads but that is as far as they can go. The successful movement of shipments depends on us as railroad men. We must be sure that cars are loaded in strict compliance with the rules.

As railroad men and as officers in the car departments of our railroads, it is our responsibility to know that the inspectors selected to enforce the loading rules and to select the cars on and in which shipments are to be made are competent successfully to perform the duties assigned to them; that these inspectors have a thorough knowledge of the rules; and that they are sufficiently forceful in the performance of their duties to handle their work with the loading foremen at the various loading points and to do so in a tactful manner. If we do these things we will continue to move with dispatch and safety the enormous quantity of material which is so urgently needed by our Army and our Navy, by our own civilian population, and by our neighbors and our allies throughout the world.

Counterbalance Tests

Limits of reciprocating unbalance determined in terms of locomotive weight—Tests include a complete study of the action of forces set up by unbalanced rotating reciprocating weights on the locomotive and track structures

[IN MARCH, 1944, a report on Counterbalance Tests of Locomotives for High-Speed Service was issued by the Office of the Mechanical Engineer, Mechanical Division, and Research Engineer, Engineering Division, Association of American Railroads. The report contains over 300 pages. It presents the results of the study of the Committee on Locomotive Counterbalance Standards of the Mechanical Division and of the Joint Committee on Relations between Track and Equipment of the Mechanical and Engineering Divisions, culminating in a series of tests for the measurement of the effects of inertia forces on the locomotive and on the track affected by counterbalancing. This article is based on that report. It is confined to a presentation of the objects of the tests, the test program, and the conclusions drawn from the analysis of the test data.—EDITOR.]

Fundamentally, locomotive counterbalancing involves the balancing of revolving and reciprocating masses in the locomotive mechanism to prevent undue disturbances of the locomotive and without producing conditions which are damaging to the track or bridges over which the locomotive must operate. In reviewing the development of locomotive counterbalancing certain phases or questions have evidently been of continued interest throughout and it may properly be stated that these questions had not definitely been settled at the time the tests described in this report were undertaken. These are:

1. The proper relation or limitation of the amount of reciprocating weight with respect to the weight of the locomotive.
2. The amount of reciprocating weight that can be left unbalanced without undue disurbance of the locomotive.
3. The method of balancing the mainrod, whether statically based upon the scale weight of each end or dynamically based upon its center of percussion.
4. The extent to which it is necessary or desirable to balance the out-of-plane effect of the revolving weights commonly referred to as cross-balance.
5. The extent to which it is necessary or desirable to balance the eccentric cranks and eccentric rods.
6. The amount of dynamic augment that can be tolerated by the track.

Obviously, these questions have assumed increasing importance as the speed of operation of locomotives has increased. The present A.A.R. recommendations for counterbalancing as adopted in 1931 and revised in 1934 were definitely shown to require revision by experiences on several railways with modern high-speed locomotives of the 4-6-4 and 4-8-4 types which kinked rails in regular operation although balanced in accordance with these recommendations. Accordingly, the Mechanical Division of the A.A.R. established a Committee on Locomotive Counterbalance Standards to give this matter thorough consideration, and C. H. Buford, vice-president of Operations and Maintenance Department, established a Joint Committee on Relation between Track and Equipment, consisting of representatives from the Mechanical and Engineering Divisions, to afford the necessary coordination between the interests of track and equipment on this and other matters.

The first step taken by the Committee on Locomotive Counterbalance Standards was to prepare a comprehensive analysis of the theory of locomotive counterbalancing. This afforded the background and basis for the analytical treatments.[1] It was next decided that extensive field tests should be made of various types of locomotives and careful consideration was given to the plan of conducting these tests.

Test Program

It was decided that the following program should be followed for the tests.

The tests should be conducted on single track so there would be no reason to expect the rail to have better support under one side of the locomotive than on the other. Otherwise, the tests would have to be duplicated, running the locomotive in both directions, in order to determine the relative impacts on the rail under right and left drivers.

The rail should be 100 lb. per yd., a comparatively light section for high-speed main-line use. There should then be no question but what rail stresses in heavier rails would be less than in the 100-lb. section. Also, the higher stresses in the lighter rail section would afford somewhat more accuracy of measurement.

The track should have tie plates, tie and ballast that would afford a standard of rail support comparable with average main-line track and be suitable for 100 m.p.h. speed.

The alignment of the track should be tangent at the test section and should have an alignment and grades each way from the test section to permit test speeds of 100 m.p.h.

It was decided that four locomotives should be selected for the tests, one each of the 4-6-2, 4-6-4, 4-8-2, and 4-8-4 types.

The counterbalance condition of each locomotive selected should be checked and analyzed by the committee method to determine the amount of unbalance producing dynamic augment, the amount of reciprocating compensation and of reciprocating unbalance, and the locomotive should be tested with this counterbalancing (the same as used on the locomotive prior to the tests) to determine its effect on track and its riding qualities.

[1] Section IV of the report develops a complete mathematical analysis of the action of forces set up by unbalanced rotating and reciprocating weights and the vertical component of piston load due to the angularity of the main rod, including sample work sheets.—EDITOR.

The main driving wheels of the locomotive should then be rebalanced by the committee analysis to provide the same effective reciprocating compensation and the tests repeated for comparison with the first series.

In order to determine the maximum permissible unbalanced reciprocating weight in terms of the total weight of the locomotive in working order, two additional series of tests should be run with each locomotive with different amounts of unbalanced reciprocating weight so the complete range of reciprocating compensation within feasible limits of operation would be covered.

Each locomotive should be tested at a speed of 5 m.p.h., at diameter speed, and at high speed—as near 100 m.p.h. as possible. In order to secure a good average, five runs should be made at each speed working steam, and at diameter speed five additional runs should be made drifting.

It was decided that test equipment should be obtained to determine the vertical and lateral effects on the track, and the vertical, lateral, and longitudinal vibrations of the locomotive, the lateral thrusts applied by the driving boxes to the frame, and stresses in the main driver pedestal jaws.

Some changes were found necessary or desirable in this test program. However, in general, the tests were carried out in accordance with the program as outlined. Due to the shortage of power as a result of wartime demands, it was not possible to make the proposed tests with the 4-8-4 type of locomotive, but the other three types were obtained.

Test Equipment

Past experience had shown that the dynamic vertical wheel loadings applied to the track could be well determined from measurements of longitudinal strain in the base of the rail. For measuring the dynamic lateral forces, it was decided to use a modification of a roller-bearing tie-plate assembly which had been developed and used successfully on the Pennsylvania.

For determining the effects of counterbalancing on the locomotive it was decided to use accelerometers to measure the vertical, lateral, and longitudinal vibrations, to measure the lateral forces between the driving boxes and frame by special weigh-bar mechanism, to measure the strains in the main driver pedestals, and to measure the strain in the drawbar between the locomotive and the tender. During the course of the tests it was decided to measure in addition the main-rod thrusts, the steam pressure in the cylinders, and the variation of the sprung weight transmitted to the main driver.

Careful study was given to the selection of the type of equipment that would be most suitable. The electromagnetic type of measuring equipment had received the benefit of several years of experience and progressive development. It was considered that this type of equipment had satisfactory characteristics, and in view of this background of development and experience and satisfactory performance would be best suited for test work. Accordingly, specifications were prepared covering the features that were considered necessary, and the Hathaway Instrument Company was engaged to design and construct the equipment in accordance with the specifications. This equipment consisted of four oscillographs, each capable of making 12 simultaneous records; four control units, each of which was operated in conjunction with one oscillograph, to govern the sensitivity, rectify and filter the output from the gauges; two electronic-type oscillators for providing the necessary 2,000 c.p.s. carrier current for the gauges; 72 magnetic strain gauges, and 10 magnetic accelerometers. Part of this equipment was used for the track measurements and part for the locomotive measurements.

The stretch of main track selected was the same as used previously in conducting counterbalance tests with Chicago & North Western locomotives near Harvard, Ill. This track is part of the C. & N. W. short line between Harvard and Janesville, Wis. Traffic was favorable to the tests on this line since the railway has two single-track main lines between these points and a majority of all trains used the other line. The test track was laid with 100-lb. rail, had good surface, line and tie condition.

A summary of the operation of the three test locomotives while making test runs is shown in the table.

Effect of Counterbalancing on the Locomotive

Acceleration of the Locomotive Frame

The locomotive frame and the superstructure supported thereon represent a spring-borne mass which is subjected to disturbing forces from the driving mechanism and also from irregularities in the line and surface of the track. Measured rates of acceleration of this spring-borne mass indicate the amounts and directions of these disturbing forces. By obtaining a mean acceleration curve throughout a driver revolution for a number of wheel revolutions and runs, the disturbing forces from track irregularities are averaged out and an indication is afforded of the extent of the disturbing forces due to the driving mechanism alone.

The effect of the amount of reciprocating unbalance on the accelerations of the spring-borne mass of the locomotive is shown in Figs. 1 and 2. In these figures, the maximum range of measured lateral and vertical accelerations is plotted with respect to the amount of unbalanced reciprocating weight.

The front lateral accelerations, shown in the upper portion of Fig. 1, are of moderate magnitude and not greatly different for all three locomotives. In general, there is a small increase in the magnitude of the front lateral acceleration as the reciprocating unbalance increases.

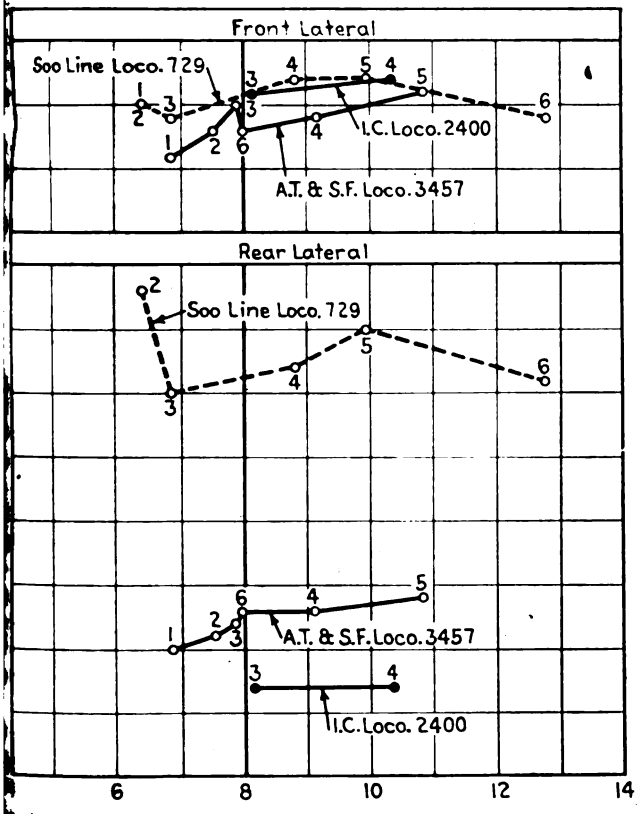
The rear lateral accelerations show a slight increase in magnitude as the reciprocating unbalance is increased for the Santa Fe system locomotive only. Of most significance however, were the high magnitudes of rear lateral accelerations for the Soo Line locomotive, irrespective of reciprocating unbalance. This was attributed to the low latera

A Summary of the Operation of Three Locomotives in the Counterbalance Tests

Road	Loco. No.	Type of loco.	Fuel	Diameter of drivers, in.	Total weight of engine in-working order, lb.	Weight of reciprocating parts on one side lb.	Weight of reciprocating parts, per ton of engine weight, lb.	Range of outside temperature, deg. F.	No. of test series	No. of tests run	No. of cars in train	Tonnage of train	Test train road mileage
Illinois Central	2400	4-8-2	Coal (stoker)	73½	362,500	1,946	10.7	30-84	4	171	5	265	1,885
Minneapolis, St. Paul & Sault Ste. Marie	729	4-6-2	Coal (hand)	75	271,100	1,737	12.8	54-92	6	176	3	234	2,369
Atchison, Topeka & Santa Fe	3457	4-6-4	Oil	79	352,600	1,896	10.7	57-95	6	148	5	374	2,073
Totals									16	495			6,327

resistance of the trailer truck which varied from 6 per cent initial to 17 per cent of the weight on the trailer wheels. It is quite evident that other characteristics of locomotive design had far more influence on the rear lateral accelerations than the amount of reciprocating unbalance.

The measured lateral accelerations for each locomotive and each test series showed a definite relation with the calculated nosing couple due to the unbalanced reciprocating weight. This nosing couple is only moderately affected by a relatively large change in the amount of reciprocating unbalance. Furthermore, the engine and trailer trucks may be designed to confine the lateral accelerations within moderate magnitudes even with no



Vertical scale: Mean maximum range of accelerations in units of g (32.2 ft. per sec. per sec.) — Horizontal scale: Reciprocating unbalance in pounds per side per ton of locomotive weight in working order — Numbers on the curves refer to test series

Fig. 1—Lateral accelerations of the locomotive frame — A comparison of the mean maximum for the three test locomotives operating at high speed

reciprocating compensation. It is, therefore, evident that in determining the proper amount of reciprocating compensation for a locomotive, compensation for the nosing movement is of secondary importance.

The front vertical accelerations in the upper portion of Fig. 2 show a definite trend toward higher accelerations with increasing reciprocating unbalance, except for the Soo Line locomotive. The rates of acceleration are not greatly different for these locomotives and may be considered moderate. In the lower portion of this figure showing rear vertical accelerations, the curve for the Soo Line locomotive has been omitted due to the sensitivity of the accelerometer varying during the test. There was a very considerable increase in the rear vertical accelerations of the Santa Fe locomotive for Series 4 and 5 to magnitudes that are excessively high. The rear vertical accelerations appear to have a definite relation to the drawbar buffing force and it seems quite probable that these high magnitudes for Series 4 and 5 may be primarily influenced by the drawbar and buffer characteristics.

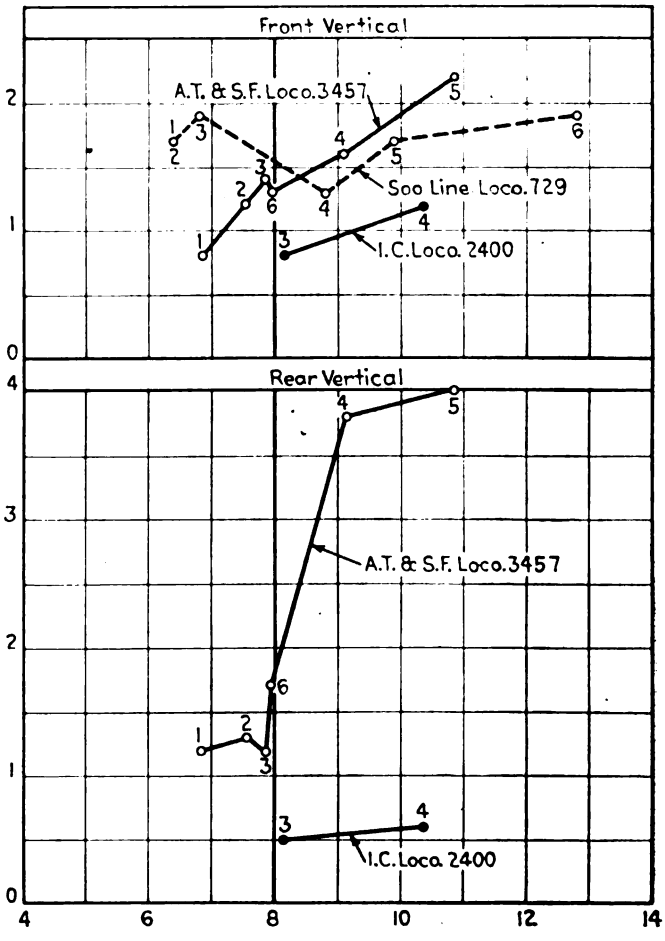
The fore-and-aft accelerations were measured for Series 3 and 4 with the Illinois Central locomotive and for Series 2 to 6, inclusive, with the Soo Line locomotive. The measured accelerations corresponded closely with the calculated values based upon the mass of the locomotive and the fore-and-aft shaking force. The measured fore-and-aft accelerations increased with the amount of reciprocating unbalance but were of moderate magnitude.

It seems evident from the test measurements that the fore-and-aft disturbing force, because of its direct effect on the fore-and-aft accelerations and indirect effect on the vertical accelerations, should receive primary consideration in the arrangement of the counterbalancing.

Main Driver Pedestal Stresses

In Fig. 3 the maximum range of main driver pedestal stress for each test series measured at high speed is plotted for each of the test locomotives with respect to the amount of reciprocating unbalance. In 16 test series with the three locomotives the highest pedestal stress for the locomotive was measured in the left rear pedestal, except in the sixth test series with the Soo Line locomotive.

For all locomotives it was found that simultaneous peak stress values occurred in diagonally opposite pedestals, indicating a twisting of the main driving axle in the horizontal plane and these peak values corresponded closely with the pin position for the maximum calculated nosing



Vertical scale: Mean maximum range of accelerations in units of g (32.2 ft. per sec. per sec.) — Horizontal scale: Reciprocating unbalance in pounds per side per ton of locomotive weight in working order — Numbers on the curves refer to test series

Fig. 2—Vertical accelerations of the locomotive frame — Comparison of the mean maximum for the three test locomotives operating at high speed

couple due to the inertia of the reciprocating weight. The maximum pedestal stresses in the high-speed runs for each test locomotive varied moderately during the several test series, but were no larger than the stresses measured at low speeds when the locomotive was accelerating.

It is apparent that main driver pedestal stresses are influenced by conditions other than the amount of reciprocating unbalance and piston thrust, such as clearances between the driving-box shoes and wedges and rod bushings clearances on the crank pins. In these tests, stresses measured in the main driver pedestals in high-speed operation for all locomotives were not excessive, regardless of counterbalancing.

Lateral Forces on the Locomotive Frame

For the tests with the Illinois Central locomotive only, the lateral forces exerted by the driving wheels on the frame were measured with specially designed weigh bars. No definite relation was shown between these forces and the amount of reciprocating unbalance, and these measurements were not made for the other two locomotives.

Variation of Sprung Load on Main Drivers

The variation in sprung load on the main drivers showed two principal characteristics. First, a cyclical change occurred during each wheel revolution, the sprung load being decreased as the dynamic augment increased, and vice versa. Apparently, an increase in dynamic augment increased the wheel depression on the elastic track structure, tending to release a part of the spring flexure and reaction. Second, a cyclical transfer of sprung load occurred over a period of four to five driver revolutions, between the right and left main drivers, reflecting a roll of the locomotive superstructure on the springs. This roll appeared to be primarily influenced by track surface and alignment.

The change in sprung load partially explains the scatter in the measured rail stresses between successive runs, but has little significance in determining the proper amount of reciprocating compensation.

Drawbar Pull

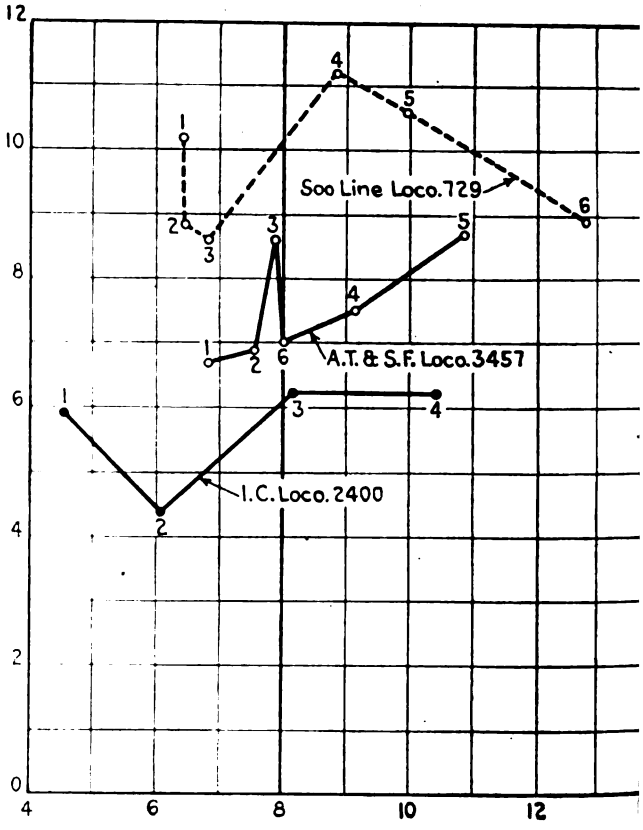
The variation of the drawbar pull throughout the driver revolution showed interesting changes between the different test series. It is significant to note that the maximum measured drawbar pull lagged the maximum calculated forward force. For the Soo Line locomotive tests, the maximum drawbar pull did not increase as the reciprocating unbalance was increased. For the Santa Fe engine tests, the maximum drawbar pull showed somewhat more than a proportionate increase as the reciprocating unbalance was increased, corresponding approximately in amount with the calculated forward force. The variation in drawbar pull is quite large during a driving-wheel revolution. The measurements indicate that an increase in reciprocating unbalance increases the magnitude of this variation, but that this increase can be offset to a large extent by the design of the buffer between the locomotive and tender and also the draft gear on the tender. Therefore, the amount of reciprocating unbalance need have little influence on the shuttling of the train.

Amount of Reciprocating Unbalance

A primary purpose of the tests was to determine the proper amount of reciprocating compensation, and the various test series with the three locomotives included reciprocating compensation within a range of 56 per cent to 0. Since the extent of the disturbance of the locomotive depends upon its mass and the amount and frequency of the disturbing forces, a good yardstick to use is the amount of reciprocating unbalance per side per ton of locomotive weight in working order. The tests covered a range of reciprocating unbalance from 4.6 to 12.8 lb. per ton of locomotive weight.

The various test measurements with these three locomotives show that the disturbing effects upon the locomotive of the reciprocating unbalance were moderate when the reciprocating unbalance did not exceed 8 lb. per ton. In the judgment of the cab observers, little difference could be detected in the riding qualities for this or a less amount of reciprocating unbalance.

For the test series having larger amounts of reciprocating unbalance, the test measurements show high



Vertical scale: Mean maximum measured pedestal stresses in units of 1,0 lb. per sq. in. — Horizontal scale: Reciprocating unbalance in pounds p side per ton of locomotive weight in working order — Numbers on t curves refer to test series

Fig. 3—Stresses measured in the main driver pedestals — Comparis of mean maximum range for the three test locomotives operating high speed

disturbing effects particularly for the Santa Fe locomotive for which locomotive the rear vertical acceleration were excessively high with 9.1 and 10.9 lb. per ton of reciprocating unbalance. In the judgment of the ca observers the Illinois Central locomotive was rough wit a reciprocating unbalance of 10.4 lb. per ton; the So Line locomotive somewhat rough with 8.8 lb. per ton rough with 9.9 lb. per ton, and unsatisfactory with 12. lb. per ton; the Santa Fe System locomotive rough wit 9.1 lb. per ton and unsatisfactory with 10.9 lb. per ton.

Effect of Counterbalancing on the Track

Vertical Forces Exerted Upon the Track

The vertical forces exerted upon the track at high speed are influenced by the revolving unbalance, vertical component of the main-rod thrust sprung and unsprung

load, and various impact effects not related to the counterbalancing. The amount of the vertical force is indicated by the longitudinal bending stress along the center line of the base of the rail. By plotting the measured stresses for a number of test runs, the mean value of these stresses may properly be considered to average out the impact effects not related to counterbalancing and provide a basis for studying the effects of counterbalancing alone.

The measurements for all test locomotives show a remarkably close agreement in general with the calculated values. It is believed, therefore, that the theory for calculating the resultant disturbing forces may be used with full confidence.

The measured rail stresses obtained in the tests with the various amounts of revolving unbalance in the driving wheels show a definite reduction in the dynamic augment effect as the reolving unbalance is reduced. For very low amounts of revolving unbalance, the dynamic augment effect is entirely negligible. As the revolving unbalance is increased, the dynamic augment effect becomes more and more pronounced until a very decided vertical oscillation of the driving wheel is produced.

Lateral Forces on the Track

The lateral forces on the track were determined by means of special roller-bearing tie plates. For all test locomotives, there was little relation shown between the lateral forces and the amount of reciprocating unbalance. The main driver alone showed a well-defined relation of lateral force to pin position. This lateral force is closely related to simultaneous values of the vertical component of the thrust in both main rods and the couple produced by these components tending to rotate the main axle in a vertical transverse plane. The lateral forces on the track as well as the lateral accelerations of the locomotive are evidently a minor consideration in determining the best counterbalancing of the locomotive.

The leading and trailing wheels of all three locomotives showed a quite definite general tendency to bear to the left.

Distribution of Reciprocating Compensation

The measured rail stresses indicating the vertical forces exerted upon the track are helpful in determining how best to distribute the reciprocating compensation among the driving wheels. As the overbalance is decreased, the measured rail stresses show an increase in the amount of scatter. Apparently, the periodic disturbing force from the overbalance tends to break up random impacts not associated with counterbalancing. In the tests there was found to be little advantage in placing less than 100 lb. overbalance in any driving wheel. As the overbalance is increased over this amount, the dynamic augment effect is increased, but was not judged to be excessive up to an overbalance of 200 lb.

The main driving wheel is subject to the two-cycle per revolution vertical component of the main-rod thrust in addition to the one-cycle per revolution variation due to the overbalance. The effect of this is definitely shown in the measured rail stresses. From the standpoint of rail stresses, the tests indicated that it might be advisable to place 50 lb. less overbalance in the main driving wheels than in the coupled wheels to compensate for this effect.

Balancing for the out-of-plane or nosing effect of the reciprocating weight does not appear desirable. The tests have shown that this has little effect on the lateral accelerations of the locomotive. The vertical component of the main-rod thrust has a two-cycle per revolution variation and it is impossible to balance either it or its out-of-plane effect with a balance weight or weights in the driving wheel. Consequently, balancing the out-of-plane effect of the reciprocating weight would be at the expense of the more important fore-and-aft balancing for a given limitation on the overbalance.

Method of Balancing

The close agreement of the measured rail stresses with those calculated from the vertical forces determined by analytical treatment serves to verify the accuracy of this treatment. The calculations for the balancing of the main drivers, therefore, should be carried out on that basis.

In balancing the coupled drivers, the only advantage in balancing for the out-of-plane effect of the revolving weights would be to provide more balancing to oppose the nosing effect of the reciprocating weight. Since the tests have shown this to be of relative unimportance, there is no advantage in going to this refinement for balancing the front and rear drivers. For the 4-8-2 type locomotive tested there would be some advantage in balancing the intermediate drivers for the out-of-plane effect if it is greater than 25 per cent of the desired reciprocating compensation. This will tend to keep the dynamic augment effects from each wheel on one side of the locomotive in unison, which is somewhat beneficial from the standpoint of rail stresses.

Regardless of the method of balancing used, the resultant revolving unbalance should be determined for each wheel by the committee method.

Conclusions

Method of Balancing

High-speed operation of both passenger and freight locomotives requires further refinements in the counterbalancing of locomotives than has been the general practice in the past. The refinements considered necessary are:

a—Determine the rotating equivalent of the main rod by the pendulum or center-of-percussion method and balances this weight on the main pin instead of the full back-end scale weight of the main rod.

b—Consider the center of gravity of the eccentric crank to determine its dynamic component forces acting parallel and perpendicular to the crank-pin diameter.

c—Take into account the eccentric-rod equivalent acting at the small end of the eccentric crank.

d—Transfer the revolving weights into two equivalent revolving unbalance components—one parallel with and the other 90 deg. to the crank-pin diameter in the counterweight plane of both right and left main drivers.

e—Provide sufficient counterweight in both right and left main drivers to offset exactly these components and add the desired amount of reciprocating compensation in each wheel.

Amount of Reciprocating Compensation

The test results have definitely shown that within the limits of 56 per cent to zero reciprocating compensation, that is, from 4.6 to 12.8 lb. per ton reciprocating unbalance, the disturbing effects on the locomotive are somewhat increased as the reciprocating compensation is reduced. These disturbing effects were judged to be undesirably high when the reciprocating unbalance was more than 8 lb. per side per ton of total locomotive weight in working order.

The test results have also shown that an overbalance of 100 lb. per wheel for all drivers shows a very low

dynamic augment effect on the track and little advantage of a smaller unbalance is indicated. The dynamic augment effect increases as the overbalance is increased, but was not judged to be excessively high up to 200 lb. overbalance per wheel. Beyond 200 lb. the dynamic augment effect on the track became undesirably high.

Because of the added disturbing effect of the vertical component of the main-rod thrust, some advantage may be obtained by placing 50 lb. less overbalance in the main driving wheels than in the coupled wheels.

By the use of lightweight reciprocating parts in the construction of new locomotives or modification of existing locomotives, it will be possible to stay well within both of these limits and provide a balancing which will give very favorable effects on both locomotive and track, in so far as the disturbing forces from the reciprocating weight and dynamic augment are concerned, up to operating speeds equal to 1.5 times diameter speed. For locomotives having small diameter driving wheels, the use of lightweight side and main rods, in addition, may make it possible to provide the desired balancing of the main drivers.

Related Matters

The tests have definitely indicated that the characteristics of the engine and particularly the trailing trucks and of the drawbar and buffer between the locomotive and tender have a very important influence on the riding qualities and vertical and lateral accelerations of the locomotive at high speed.

Partial List of Material and Equipment on the Baldwin-Westinghouse 4,000-hp. Diesel-Electric Locomotive

Power Plant:	
Fuel injection system	Bendix Aviation Corp., Scintilla Magneto Div., Sidney, N. Y.
Lube oil filter	Puralator Products, Inc., Newark, N. J.
Engine governor	Woodward Governor Co., Rockford, Ill. Pickering Governor Co., Portland, Conn.
Air filters	Burgess Battery Co., Acoustics Div., Chicago
Mufflers	Maxim Silencer Co., Hartford, Conn.
Radiator shutter control	Minneapolis-Honeywell Regulator Co., Minneapolis 8, Minn.
V belts	Dayton Rubber Mfg., Dayton 1, Ohio
Radiators	Modine Mfg. Co., Racine, Wis.
Air compressors	Gardner-Denver Co., Quincy, Ill. Westinghouse Air Brake Company, Wilmerding, Pa.
Radiator fans	Buffalo Forge Co., Buffalo 4, N. Y.
Cab windows	Hunter Sash Co., Inc., Flushing, N. Y.
Defroster fans	Diehl Mfg. Co., Somerville, N. J.
Sanders	The Prime Manufacturing Co., Milwaukee 4, Wis.
Headlight, classification lamps	The Pyle-National Company, Chicago 51, Ill.
Air horn; brake equipment; intercooler	Westinghouse Air Brake Company, Wilmerding, Pa.
Operating compartment seats	Heywood-Wakefield Co., Gardner, Mass.
Speed indicator	Jones-Motrola Sales Co., Stamford, Conn.
Vestibule curtain	The Adams & Westlake Co., Elkhart, Ind.
Pipe covering; soundproofing	Johns-Manville Sales Corp., New York
Couplers	Buckeye Steel Castings Co., Columbus, Ohio
Draft gear	W. H. Miner, Inc., Chicago
Steam generator	Vapor Car Heating Co., Chicago 4.
Steam-heat connectors	Barco Manufacturing Co., Chicago 40.
Roller bearings	SKF Industries, Philadelphia, Pa. Timken Roller Bearing Co., Canton, O.
Truck wheels; truck-axles	Standard Steel Works, Division of the Baldwin Locomotive Works, Philadelphia, Pa.
Trucks	General Steel Castings Corp., Eddystone, Pa.
Truck brake equipment	American Brake Div., Westinghouse Air Brake Company, Swissvale, Pa.
Hand brake equipment	National Brake Co., New York.

Baldwin-Westinghouse 4,000-Hp. Road Diesel

(*Continued from page 191*)

from the engine bed plate and the armature is connected directly to the crankshaft. The armature shaft has one self-aligning roller bearing. A multiple Vee pulley on an extension of the armature shaft drives the auxiliary generator-exciter set which is mounted on the main generator frame. A starting field on the main generator permits starting the engine from the battery.

The four Westinghouse 370-B traction motors are nose suspended and geared to the outer axles in each truck. The gear ratio is 21:58 and the maximum speed 90 m.p.h. The motors are force-ventilated, the air being supplied by separate fans blowing air through the center-pin and truck frame. Class B insulation is used on both motors and generators.

The auxiliary generator of the generator-exciter set supplies power for charging the 56-cell storage battery, and the control and lighting circuits. A voltage regulator holds a constant voltage on the auxiliary generator at all engine speeds. The exciter is of the differential type and furnishes power for exciting the fields of the main generator. It serves properly to load the engine in conjunction with the engine control load regulator. It is also wound with Class B insulation. The control is electro-pneumatic and provides for two steps of field shunting. Transition from full field to shunted field is automatic. The governor operator is of the pneumatic type, a movement of the throttle handle resulting in a corresponding movement of the governor operators on each of the two engines. Loss of lubricating or fuel oil will automatically shut down an engine.

The unit switches connecting the generators and traction motors are of the electro-pneumatic type and are equipped with blow-out coils and arc chutes. The reversers are also electro-pneumatic and magnetic type contactors are used for the field circuits. Wheel slip relays automatically reduce power when wheels slip and give an audible indication in the operating cab.

Trucks, Draft Gear and Miscellaneous Equipment

These locomotives are carried on General Steel Castings Company's six-wheel pedestal type trucks having one-piece frame construction, side equalizers, coil springs and with the swing bolsters carried by elliptic springs at the four corners of the bolster. The front and rear axles of each truck are the driving axles, the center axle being an idler. Motor ventilation is through the center pin. The brakes are of the clasp type with flanged brake shoes. The brake cylinders are located on the truck frame. The axles are mounted in roller bearings. The truck wheels are 40 in. in diameter.

The operating brake equipment is Westinghouse Air Brake Company's Schedule 24-RL with pedestal brake stand and self-lapping brake valve. Automatic and straight air brakes apply on all wheels with train line connections at both ends of each locomotive unit. A hand brake is connected to one truck, with the operating lever in the engine compartment. Air is supplied by a two-stage compressor at each power plant having a displacement of 115 cu. ft. at 625 r.p.m. and 46 cu. ft. at the idling speed of 250 r.p.m. Three reservoirs having a total capacity of 44.530 cu. in. are suspended from the underframe.

Friction draft gear is applied to both ends of the locomotive.

Train heat is supplied by a Vapor-Clarkson steam generator having a capacity of 2,500 lb. per hr. This unit is self contained, with automatic controls and necessary gauges.

Testing Modern Trucks for

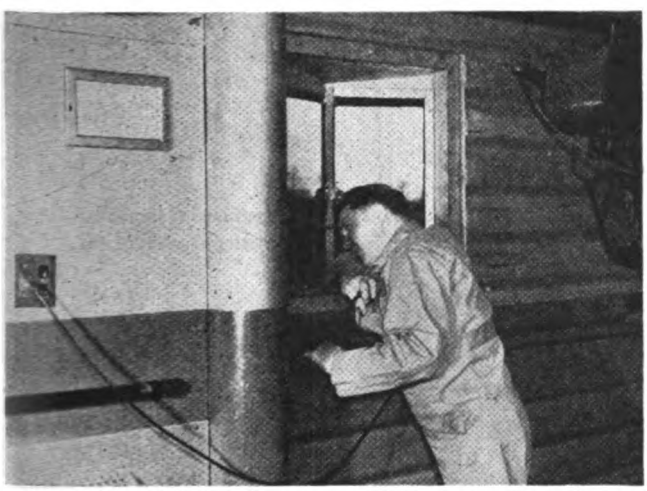
High-Speed Freight Service*

By C. L. Heater†

Service testing provides the data needed in designing of improved freight-car trucks—Truck designs a compromise between various non-controllable cost and engineering factors

THE need for freight-car trucks that would deliver safe, easy-riding service under modern operating conditions was brought out very forcibly in the series of high speed tests made by the Association of American Railroads in 1939 on the Pennsylvania Railroad between Altoona, Pa., and Lockhaven. The results of these tests, in general, indicated the need for further development to achieve satisfactory trucks for freight service at speeds over sixty m. p. h.

The American Steel Foundries has long been active in the development of freight car trucks, and much of today's excellence in the quality, strength, endurance, and economy of modern cast-steel side frames and truck bolsters is due to this development activity over the past forty years or more. That work aided in making possible the further development in modern trucks by minimizing the truck designers' concern over details of side-frame or bolster design. Thus we have been able to concentrate on the later and broader problem of providing safe, easy riding.



The observer operates a coding switch which marks 13 charts simultaneously

In our approach to the development of freight-car trucks for modern service, which is high-speed service, we feel that there are five basic requirements for such trucks: Safety, easy riding, low first cost, low maintenance, and light weight.

Safety needs little elaboration. Any truck today must be safe from the standpoint of structural strength and from the standpoint of truck operation or behavior for speeds up to 100 m. p. h. under any load which it may be expected to carry. Only careful testing, corroborated by actual service, can determine safety.

Easy riding does not necessarily mean riding qualities that compare with passenger equipment. It does mean the elimination of harsh, sharp shocks and the reduction of other impacts to the point where freight lading will not suffer damage due to truck action. There are two design factors requisite for easy riding—long travel springs and proper control of spring action.

Low first cost is an objective for any product, and here it assumes importance because the freight car is a revenue-producing unit and there are limits, arbitrarily established, upon its earning capacity in the form of freight rates. Obviously, therefore, there are limits upon its initial cost.

Low maintenance is essential in freight trucks for obvious reasons. They cannot be periodically maintained by the same crews at fixed points, they must be easily inspected and handled through repair points, they must be inexpensive to maintain, and they must be sturdy; so, all of these, and many other lesser reasons, demand simplicity.

Light weight is required to maintain an economical ratio between dead-load and revenue load in freight-carry-

Floor windows are located in each corner of the car for observing truck action

* A paper presented before the Eastern Car Foreman's Association in New York on February 9, 1945.

† Vice-president engineering, American Steel Foundries, Chicago.

ing equipment. Modern train service makes this increasingly important.

With these fundamental requirements in mind, we established an objective for a continuation of our testing and development—to develop a freight-car truck meeting fully all of the five fundamental requirements but within the general price and weight range of the ordinary conventional freight car truck.

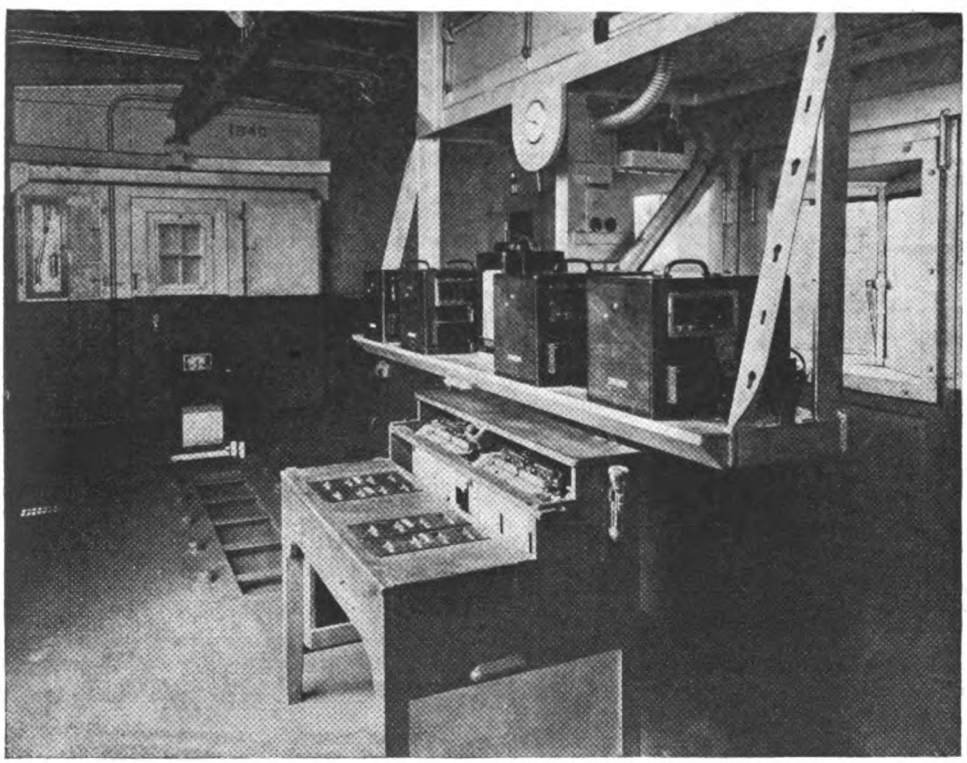
To do this required design, production and testing experience and, in addition, road testing equipment and facilities. We had the experience background; so, following the A. A. R. 1939 tests, we followed the A. A. R. suggestion and acquired the equipment we lacked for this purpose.

Equipment on Test Cars

We purchased two A. A. R. standard 50-ton box cars and equipped them as a service laboratory for testing trucks at any speed or load or under any conditions under which freight cars might be expected to operate. The instrumentation of these cars is as complete as we could make it, and we are still constantly improving it. Duplicate sets of two types of accelerometers are mounted at each end of each car on rigid plate supports anchored directly to the body bolsters. This eliminates any errors or variables due to floor conditions and affords an accurate determination of the relative performance of the trucks themselves under both cars. One set of accelerometers measures vertical impacts only, normally in terms of .25G, .50G, .75G, and 1.25G, and the other measures vertical, lateral and longitudinal impacts or accelerations and charts them graphically without differentiation as to numerical value. The accelerometer readings are charted continuously.

Truck spring deflection is measured continuously on one truck on each car and is charted. Deflections are recorded for both groups simultaneously, indicating the effect of roll, rail joints, etc. Speeds are charted by a recording speedometer and are also shown continuously by indicating speedometers located in each car. All significant points along the course of the test are simultaneously recorded on all of the charts, of which there are thirteen operating during test runs, by an observer who operates a coding switch which makes possible accurate point-by-point comparison of all chart records. To supplement the instrument determinations, close observation of truck action is made possible by four large windows in the floor of each car over the trucks. Floodlighting equipment permits night or day testing.

One interesting feature of the test equipment is the method of lading. For lading we utilize cast-iron blocks weighing about two tons each and, by the use of hoists and a monorail system, the two cars can be loaded or unloaded completely in about four hours with four men. This greatly facilitates testing and also enables us to duplicate loads and distribution of load exactly in any desired combinations. Normally, testing with a light car and again with the full rail load gives sufficient data to evaluate truck performance, although frequently tests are also made at intermediate loads.



Instrument recording platform and table

Test Runs

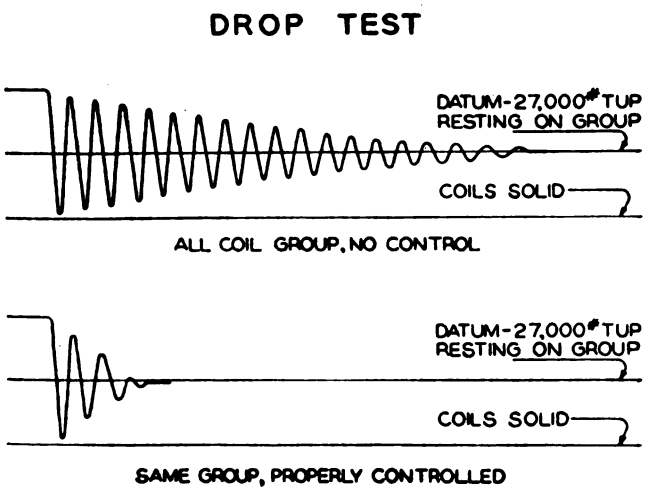
We were fortunate in being able to start our performance and development testing with the same ideal test train consist that was used in the A. A. R. 1939 tests. We also used the same design of datum truck on the base car; so, our work really was a continuation of the A. A. R. tests. First testing on the Chicago, Milwaukee, St. Paul & Pacific between Milwaukee and Portage, Wisconsin, 91 miles, from August through November, 1940, 56 test runs totaling 9,630 miles, at various speeds, the maximum being 96 m. p. h., were made. With the same special test-train on the Missouri Pacific from Little Rock to Bald Knob, Ark., 50 miles, 72 test runs, totaling 7,200 miles, were made, some at customary freight speeds with maximum rail loads but again principally at higher speeds with a maximum of 86 m. p. h.

While the special test train is the ideal method of road

testing, it is not always possible to use it; so, if development is to continue, it is necessary to make use of regular freight or passenger runs. Since the summer of 1941, the facilities of the railroads have been so busy that special test trains have been out of the question, but some test work has been done from time to time.

A series of 53 test trips between Chicago and Elkhart, Ind., on the New York Central were made from June through October, 1942, in regularly scheduled freight trains with the cars attached just ahead of the caboose. Speed was limited to a maximum of 60 m. p. h. This series added another 8,500 miles of development. During the spring of 1943 and in the spring and fall of 1944, our service laboratory cars were utilized by two western railroads for three series of truck observation tests. These were made in regularly scheduled freight runs and in express and mail trains. In these latter series a maximum of 102 m. p. h. was reached, and the trains consistently operated over some parts of the run at sustained speeds around 85 m. p. h. Twenty-six of these high-speed round trips were run, totaling approximately 12,000 miles, and 16 of the freight trips, totaling 4,000 miles, were made.

During the summer of 1944 the service laboratory cars were used for performance testing and demonstration



Comparative resonance of coil springs with and without control

between St. Paul, Minn., and Duluth, 160 miles, where 24 round trips in regular passenger trains and 10 freight trips were made, totaling another 10,500 miles. In the passenger trips the cars were coupled directly behind a Diesel locomotive and in the freight trains at the rear just ahead of the caboose.

This testing in a wide variety of services and under widely differing conditions for a total of over 50,000 closely observed and thoroughly charted miles, coupled with previous service and laboratory testing, has given us data and broad experience that could not possibly have been obtained in any other way. Our truck testing and allied developmental and research activity has cost the American Steel Foundries over $500,000, and our management thinks it is money well spent.

Coil Springs Most Satisfactory

The modern freight car truck problem is no longer one of just side frame and bolster design, but now embraces a wider field, the major factor being that of providing a satisfactory spring-suspension system to afford easy riding under a wide variation in load and speed requirements. This involves all of the elements of the truck. We have long manufactured side frames, bolsters, snubbers, brake beams, and all types of railroad and commercial springs and the data accumulated in the continuous study of these various truck elements have been most beneficial in the present development work.

The spring-suspension system of a freight-car truck must have adequate capacity to carry the maximum permissible rail load, but it must also provide a satisfactory soft ride under light car or minimum load conditions. How difficult this task is can be appreciated when it is realized that each spring group of a 50-ton box car must carry from about 7,800 lb. for an empty car to a maximum of 40,000 lb. for a fully loaded car. Under these circumstances the riding qualities of a freight car at any particular load are necessarily a compromise.

Since the two principal factors in easy riding are long-travel springs and proper control of spring action, the combination of these constitutes the basic elements of the spring-suspension system. The A. A. R. tests and those we have made have established clearly that easy riding requires long-travel springs, properly controlled. They also established that no snubbing means with A. A. R. springs, with their short travel, can make them suitable for operation in modern speed ranges; but construction and operating dimensional restrictions establish limits beyond which it is not practical to go in freight-car truck spring travel. Without detailing all of the limiting factors, we believe that about 3-¾ inch is the maximum total spring travel that can practically be employed.

Along with long total travel, a further requisite for modern speeds is adequate, reserve spring travel. This is the term applied to the amount of spring travel that remains after the car is loaded to its maximum rail load, and is important in the higher-speed ranges to cushion dynamic shocks. This is a characteristic of a modern freight-car truck; the reserve is now measured in the form of reserve spring travel rather than in its old form of reserve spring capacity.

The type of springs to be used for the modern truck is pretty nearly determined when the elements of weight and cost are taken into consideration. Nothing has been found more satisfactory for railway springs than the coil springs. That is being demonstrated in the new passenger-car trucks which are now built with practically 100 per cent coil springs. But, coil springs have a serious shortcoming which is technically known as resonance. This is the repeated bounce that takes place when a coil spring is subjected to an impact and which can be built up to violence if the impacts are repeated at the same intervals as the natural period of the spring. This takes place at what we call the critical speeds of particular spring groups. But, resonance, either at critical speeds or under the dynamic impulses at high speeds, can be controlled by introducing retardation or energy absorption into the spring suspension system. In passenger trucks this is done by hydraulic shock absorbers as a rule, and in freight car trucks we feel that mechanical friction offers the simplest and most economical method of control and have, therefore, incorporated it in our own truck development.

Over 50,000 carefully observed miles of performance testing have been run by the American Steel Foundries and some forty years of production, design and development experience have been accumulated. Combining these, we have evolved a modern freight car truck which we have designated the Ride Control Truck (A-3) which has demonstrated in test and in increasing numbers in active service its all-around suitability for all modern freight car services at any required load or speed.

EDITORIALS

A War By-Product

It is evident that the years immediately following the close of World War II will be a period of great activity in the development of railway motive power. If there were no other indications of this, it might be expected on the basis of the experience following World War I. Within the ten years after the end of that conflict appeared such innovations as the three-cylinder locomotive, the large firebox, the Type E superheater, and water-tube fireboxes of several designs. The application of roller bearings to locomotives also began during that period.

But that is by no means the only evidence of what may be expected after the close of the present war. Right now, in the midst of the war, a number of important developments in motive power are already undergoing service trials. Some of these, of course, were started before the war began, but other projects have been announced the engineering development of which is under way and the actual physical development of which will no doubt be started as soon as the nation's war job is completed. These involve completely new forms of motive power, including several applications of the steam turbine, with both mechanical and electrical transmission, and the gas turbine.

Little is being said concerning innovations in construction and machinery details, but many will be disclosed as the opportunity for their full exploitation presents itself. One innovation of this kind which will influence the future of the steam locomotive is the all-welded boiler which has already passed its period of experimental service with flying colors.

Lighting in Enginehouses

Just a few days ago, the author of this commentary was inspecting one of the most recently relighted enginehouses in the company of the designer of the installation. The open-type porcelain-enameled reflectors and the lamps were blackened to the point that they gave only a fraction of their initial output and the designer, having in mind some excellent lighting facilities he had installed at other places, said with an air of resignation, "You just can't light an enginehouse."

Judging by the great majority of installations (particularly in their present condition) the statement is completely accurate. A system such as that mentioned above looks nice when it is first put in and does a reasonably good job of lighting, but the first time someone spots a locomotive with the stack not under the jack, the lighting system suffers about a fifty per cent deterioration, and from then on it gets worse. No one cleans the reflectors, probably because they get dirty again so quickly. In fact everyone seems resigned to their poorly lighted surroundings; to have developed an apathy like that resulting from long-continued poverty.

Portable extension lights are usually furnished for local lighting, but these too fail to meet the lack of good general lighting. They are more or less fragile, their use is limited to the length of the cord and there is no place to hang them outside the running gear so that their use frequently entails one-handed work. These qualities frequently result in the reappearance of the smoky kerosene torch. It doesn't give much light, but it can be set on any flat spot; it is not fragile and it can be carried anywhere.

But in spite of all the difficulties, there are still those who keep trying to find the answer to the enginehouse lighting problem. One method which is described elsewhere in this issue appears to fill nearly all the requirements. One of its basic advantages is that it employs vapor-proof units which are less subject to corrosion and are much easier to clean than open reflectors. In some locations such units will breathe and take in a certain amount of moisture, but even with a drain hole, the reflectors will remain bright for long periods.

The use of four 500-watt units on each side of a locomotive will meet with objections from those who have been working with "marker lights," but the difference between stumbling in the dark and having good light is worth much more than the cost of almost any lighting system. Perhaps of greatest importance is the psychological effect of the light. More work is done, not only because men can see better, but also feel better. Dirt and debris gets cleaned up because it shows and since both men and management acquire pride in a good lighting system, the prospects of occasional cleaning are improved.

Just for good measure, the designers of the system described, tell of a kind of paint which has successfully inhibited corrosion of conduit and greatly prolonged its life in the corrosive enginehouse atmosphere.

It is too soon to say this is the best way to light an enginehouse (others for example are working with fluorescent lighting) but it appears to be one of the best methods available for use when the railroads again

have the opportunity to replace the many installations which have suffered from a naturally high depreciation rate during a long period when new materials were not available.

Responsibility For Cut Journals

An experienced railway car man, in commenting on the hot-box editorial in the March issue, called attention to a disturbing condition which he recently observed. While on a trip over western carriers he visited a private car line shop and noticed four completely rebuilt refrigerator cars turned out of shop with not a brass removed and the original packing used without any other attention than a little shaking up by hand.

In answer to a question, a general car foreman of the railroad on which the car shop is located acknowledged that he noticed the careless practice but said nothing could be done because of pressure brought by his traffic department to avoid any open criticism of the private car company involved. Our correspondent expressed the following opinion: "We are never going to get any place with these private line people until the A. A. R. rules are changed so that car owners are responsible for cut journals under any and all conditions, except where floods completely remove the lubrication."

The suggestion that cut journals be made an owner's responsibility has been advanced periodically for years and backed by men who, while possibly limited in number, possessed unquestioned knowledge, judgment and wide experience in railway car matters. The familiar expression "Where there's smoke there's some fire!" has a bearing in this case, and the mere fact that this suggestion keeps bobbing up indicates that it has some justification and probably some merit.

The principal argument against the suggestion is that improper servicing of journal boxes, rough handling, which causes waste grabs, and some other common causes of hot boxes are entirely under the control of the operating railroad which presumably should be willing to assume responsibility when trouble develops. The other side of the picture is that many hot boxes (sometimes estimated as high as 90 per cent) are due to deficient, non-A. A. R. standard mechanical conditions in the journal boxes and trucks as they are originally turned out of shop by the car owners. There is considerable reason to believe that, in all justice, these defects and the hot boxes which result from them should be owner's responsibility.

Many of the larger and more responsible private car companies are not subject to the criticism implied in this editorial; they have followed the policy for years of cooperating fully with individual railroads and the A. A. R. in endeavoring to keep their equipment up to standards and any noticeable decline during the last two or three years has been due to necessarily intensive wartime use. Some of the smaller companies, however, either lack proper equipment and repair methods, or else are just plain careless in car-reconditioning work, with the result that cars just out of their shops make only a few miles before hot boxes or other troubles develop; the cars have to go to the repair track; trains are delayed, and needless expense is entailed.

Private car lines are not the only offenders in using inferior equipment and methods at certain car-repair shops and wheels shops. Some railroads also fail to provide adequate equipment and supervision for this important work, and here, again, the lack is usually more noticeable at smaller outlying points. There are undoubtedly many officers of private car lines and some railway officers who would not like to see any further development of this sentiment to make cut journals officially an owner's responsibility. When they have tightened up on present maintenance practices wherever they are deficient and have eliminated the indifference and carelessness which permit rebuilt cars to go out in service with dirty packing and possibly defective wedges and brasses they will have made the only effective contribution toward changing that sentiment.

Shop Layout Is An Engineering Job

There is a growing belief on the part of many railroad shop men that the time is rapidly approaching when most of our railway repair shops where the general overhauling of motive power is carried out are due for a general overhauling themselves; that they are poorly equipped and poorly arranged for the job that is ahead of them in the post-war period. Such an opinion is not hard to understand for, generally speaking, the railroads have not carried out any extensive programs of shop modernization for many years and the men who have been responsible for getting out the work, particularly during the war period, have in front of them every day the handicaps in production which have been accentuated by the pressure under which shops have been operating for many months past—handicaps resulting from the reluctance of management to spend in the pre-war period and from the inability to secure new equipment during the war period.

Satisfactory earnings and the availability of new machine tools and shop equipment are easing the situation and creating an atmosphere wherein shop management supervisors and officers are not only looking at the immediate future with awakened interest but with enthusiasm which is being reflected in the greatest volume of buying that we have seen in many years. Under such conditions it seems distinctly out of order to inject any sour notes and yet, if we are to believe what we are told by some individuals who have made

a lifetime study of this problem, the railroads, in buying several millions of dollars worth of new equipment for repair shops, may very easily perpetuate errors that have been made in the past and fail to derive from the new equipment the economies that they have a right to expect from its installation.

It may be well to state, as a principle, that pieces of shop equipment viewed as individual units are merely tools which when arranged and utilized in proper combinations are capable of performing a production job which presumably has been planned beforehand. It stands to reason, then, that before one can buy shop tools intelligently the character of the over all job must be clearly in mind and the plans for doing that job have been developed.

A recently published book, "Industrial Management" states, in discussing plant management the fact that no two industrial plants are exactly alike; that physical arrangements will therefore differ but that all require the application of common principles, the objectives of which are: economies in handling; lower costs of useful areas; minimizing of production delays; avoidance of bottlenecks; better production control and supervision; avoidance of unnecessary and costly changes once a layout is made; improvements in production processes and methods; provision of a layout that permits meeting of competitive costs; and incorporation of safety into the physical plant as a part of the layout and organization. These are fundamental principles that apply just as surely to a railroad repair shop as they do to any large industrial production plant. They might be said to constitute a check list that should be gone over in relation to every change that is made in the shop.

Fortunately we are approaching the matter of Diesel locomotive repair shops in the right way—right in that we have accepted as a matter of principle the building of new shops instead of attempting to adapt steam locomotive repair plants to Diesel repair work. The great difference in the nature of the work demands that this be done in the interest of economy.

In the matter of steam-locomotive repair shops there is one word of caution and one important fact that is worth mentioning and that is that practically without exception our existing shops were designed, built and arranged many years ago and as far as layout is concerned remain practically unchanged, while the steam locomotive of today is no more like the locomotive of 20 or 25 years ago than night is like day. How, then, can new machine tools be purchased and dropped into place in a shop layout 20 years old and maximum economies be expected?

Another point that is important is the fact that most shops have far too many machine tools for no better reason than that, when the shop was originally built, many more locomotives were going through the shop; locomotive parts did not have the service life that they now have and the machines themselves did not have the productive capacity that present-day machines have. How, then, can any railroad justify the continuation of a shop layout and a shop inventory of equipment that may be entirely unsuited to the needs of today and the days to come?

There is only one solution to the intelligent spending of the shop-equipment dollar. We have in mind, at this writing, a railroad that is planning to spend a total of three million dollars for new shop equipment and yet that road has no shop engineering department the function of which and the responsibility of which is the assurance that that railroad gets its money's worth out of what it is going to spend. Machine-tool builders who are familiar with railroad work criticize because railroads will sometimes spend from 10 to 20 thousand dollars for a new machine and then, in a false idea of economy, refuse to spend a few hundred dollars for tooling and handling equipment that are absolutely necessary for obtaining maximum production from the new machine. A thorough study of the relation of machining time to floor-to-floor time in many shop departments would reveal such a total lack of good shop engineering as to be amazing.

The next few years will be a vital period in railroad shop rehabilitation and if the roads are going to spend millions without the benefit of good engineering planning they may as well spend the money in other directions. No railroad of any size can afford to be without a shop engineering department.

NEW BOOKS

PLASTICS CATALOG—1945. *Published by Plastics Catalogue Corporation, 122 East 42nd St., New York 17. 1178 pages, 8 in. by 11¼ in., illustrated. Price $6.00.*
This is the annual edition of a catalog of an industry which is growing so rapidly that annual revisions of material concerning it are required. It contains basic information concerning plastic materials and products and their manufacture and fabrication. Extensive charts and tabular information provide quick-reference data of individual characteristics and comparative qualities.

New material in this edition includes information on recently developed plastics, including silicones. There are also new articles on engineering designs employing plastics and on the making of plastic models. The section on laminates, plywood and vulcanized fibre has been thoroughly revised as has been the chapter on synthetic rubbers and rubber-like plastics. Synthetic fibres and coatings are dealt with at length and there is a new article on organic coatings for metals.

A directory section includes ten complete directories to all branches of the plastics industry including educational institutions, molders, material manufacturers, trade names, etc. A glossary of terminology serves to acquaint the reader with terms and definitions which are peculiar to the industry.

THE READER'S PAGE

Some Car Oils Are Not Too Good

To THE EDITOR:

We have read a great deal and heard so much about the prevention of hot boxes that one wonders sometimes what more can be done to minimize such heating failures. The fact remains, however, that in spite of all the cure-alls publicized we are not getting the results that we are all seeking.

In the summer months when hot boxes increase, we hear the cry that it is because of extremely hot weather, whereas in the winter the trouble is ascribed to the oil congealing and the packing freezing to such an extent that the rolling mass can not be treated in transportation yards. Consequently, many cars are set out enroute and occasionally a journal will burn or break off, sometimes with resultant heavy property damage. These failures are expensive and cause embarrassing delays.

Various experiments have been made to prevent waste grabs. Many railroads have been employing special devices in journal boxes and using different designs of journal bearings to that end. Despite all these experiments, I question whether we are making the right approach in solving our hot-box problems.

The matter has caused me much concern and upon exploring the situation on this railroad I have come to the conclusion that in a great many cases the cause of overheated journals can be directly traced to the quality of oil used by many railroads. It, therefore, would be my recommendation that railroads concentrate on this phase of lubrication, namely, obtaining a better grade of oil. Investigation, I think, will confirm my understanding that many railroads are buying oil in tank-car lots that is costing them little more per gallon than the oils commonly used for domestic purposes.

We should endeavor to get an oil that will give superior performance under varying temperatures. Of course, the effort must be universal and there must be uniformity of practice. Once we get the right grade of oil, there must be strict adherence to Rule 66 if the results sought are to be achieved. I am convinced of the fact that the cost of the oil should be of secondary consideration. If a good grade of oil will prevent waste grabs in severe hot weather and the rolling of waste in extreme cold weather, thus reducing heating failures, the increased price per gallon will be more than offset by the minimization of expensive failures to say nothing of the benefits derived from improved train operations.

The development of better lubricating oils for car journals to my mind presents a fertile field for thought and decisive action. I don't think it too much to hope for—witness the performance of the highly refined oils in airplanes and automobiles under extreme varying temperatures. While it is recognized that such oils are not adaptable to railway car lubrication, their development does suggest that oil companies through research could improve the film strength and other properties of car oils and offer a product that will insure better lubrication at extreme summer and winter temperatures.

Of course, a better grade of lubricating oil will not in itself prevent hot boxes if the boxes are improperly serviced and the mechanical parts neglected. For example, it has come to my attention that some railroads are rebrassing overheated journals notwithstanding the fact that they are discolored and require attention. It seems that some car department supervisors take the position that a journal must be cut to warrant its removal from service. When a train crew finds it necessary to set out a car for a hot box the damage has been done and the wheels should be changed. The practice of rebrassing the journal and repacking the box and permitting the car to go forward should be discouraged. Instead, the car should be carded to the nearest available repair point for change of wheels.

The importance of this is emphasized by the conditions found in our wheel shop. In the reconditioning of journals, a large number of journals that have run hot in service are found with thermal checks and cracks. Such axles are unfit for service and are scrapped. Obviously, the simple expedient of rebrassing cars that have been set out for a hot box constitutes a menace to efficient train operation and the practice should not be countenanced. We should be especially vigilant to prevent so far as is humanly possible delays in traffic, resultant property damage and possible injury to train personnel.

It is a well known fact that instances have occurred where axle failures have been traced to the absorption of non-ferrous metals into the steel journals. In a recent article on this subject, it was pointed out that at a temperature of about 480 deg. F. or more, the steel journal begins absorbing the brass metal, and when the journal is overheated a second time, cracks develop from the surface inwards.

It seems to me that this emphasizes my thought that it will repay us to give overheated journals the utmost attention in wheel shops to insure their suitability for service before they are again used.

In conclusion it is my thought that if this problem of oil were presented to the oil companies and a study undertaken in cooperation with the Association of American Railroads, a grade of oil could be produced that would function more efficiently in extreme weather.

G. W. DITMORE, *Superintendent Car Equipment D. & H.*

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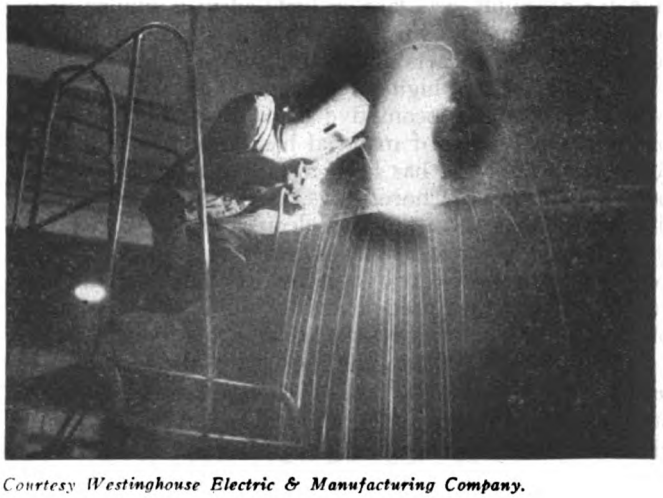


Courtesy Westinghouse Electric & Manufacturing Company.

Tender-tank repairs by arc welding

Material Delivery At C. & N. W. Shops

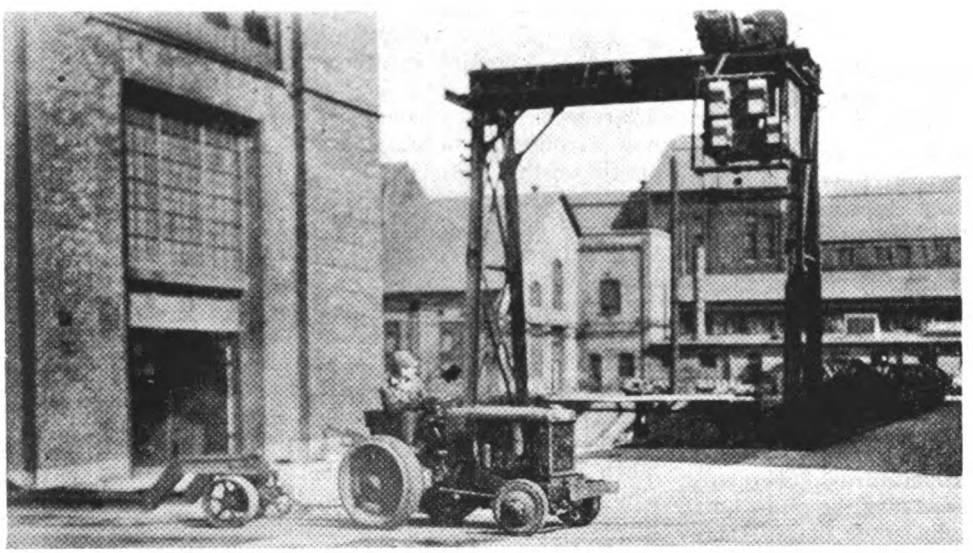
Among other important improvements already completed or in prospect for the Chicago shops of the Chicago & North Western is a completely revised and modernized method of handling small materials from the storehouse to the shops and between the various shops and departments. This material movement constitutes in itself a major operation and can be minimized only by organized procedure and the use of adequate power truck and trailer equipment. With approximately 535 mechanics employed at the C. & N. W. locomotive shops, the interdepartment movement of materials was formerly handled by means of 35 push carts, 30 hand trucks and 52 push-cars. After stripping locomotives, the parts were placed on the push-cars, rolled onto the transfer table, moved to the lye vat and each part taken off separately and placed in the lye vat. Subsequent movement to the various departments for repairs and back to the locomotive for assembly was largely handled in a similar manner, in some instances using mechanics as well as helpers to move the push carts and hand trucks.

To avoid using high-price help, badly needed elsewhere, for moving locomotive shop materials, a schedule of hourly deliveries of material has been set up and the following equipment has been installed, or will be in the near future: two Chore Boys, one 10-ton gas-electric lift truck; one three-ton gas-electric crane truck; one three-ton gas-electric lift truck, with 50 skid platforms; two three-ton gas-electric high-low lift trucks. This new equipment is being used in conjunction with a number of units of older power trucks which are still serviceable.

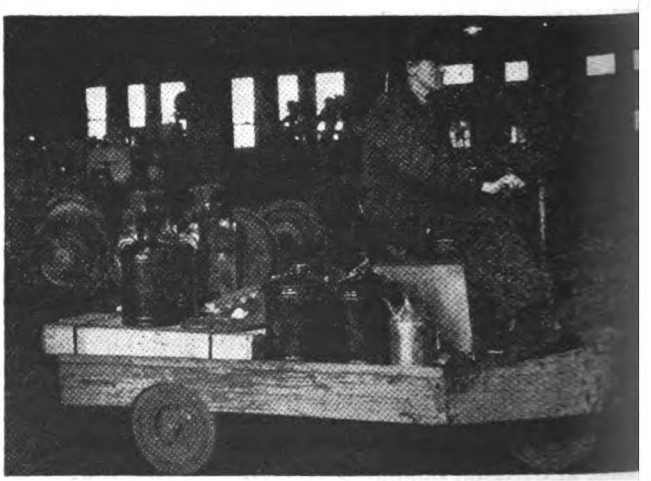
The individual shop buildings with their respective letter designations and the various material delivery stations or boxes for picking up orders and leaving materials are shown in the accompanying drawing and table. In general, two separate routes are followed, one consisting of a loop from the small materials store house S-1 to the driving wheel shop, stripping and wheeling shop, machine and erecting shop, and return. The second route connects S-1 with the Diesel train ramp, light machine shop, boiler shop, tank shop, wheel shop, blacksmith shop, and return.

Chore Boy 1 makes the first route, consisting of one round trip each hour from S-1 to Box 1 in the driving wheel shop M-49, then to Box 2 in the stripping and wheeling shop, Box 3 in the finishing shed, M-50-A, Boxes 4, 5, 6, 7, 8 and 9 in shop M-50, and thence back to the storehouse so that orders picked up on this route may be left and materials secured on requisitions delivered to the stores department on the previous trip. This Chore Boy ties up for the night at Box 7 and starts the first trip at 7:30 a. m. the next morning, picking up orders from the various boxes for delivery to S-1, then loading material which has been put up by the stores department employees on requisitions left the night before and delivering it promptly to the respective shops.

Chore Boy 2 starts from Box 10 located at the Diesel



Tractor and driving-wheel trailer outside the wheel shop—New lye vat and gantry crane in the background

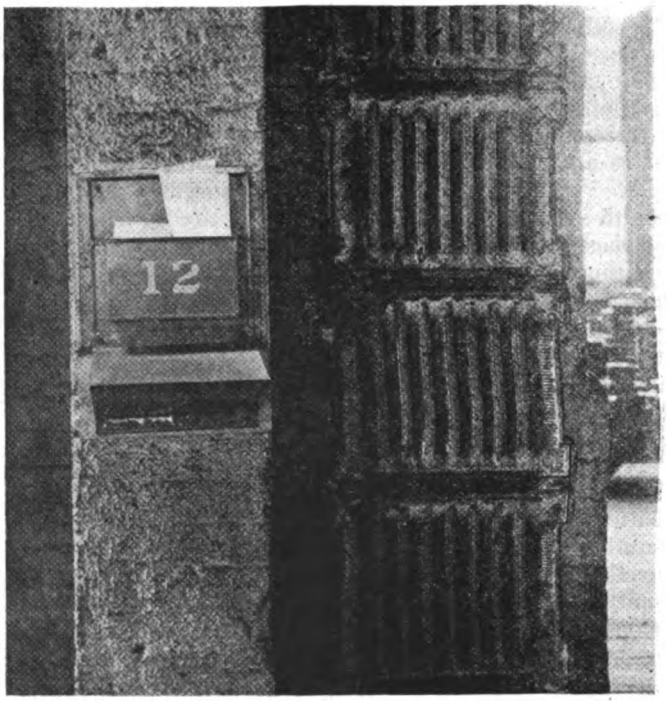


Chore Boy I delivering miscellaneous material in the machine and erecting shop

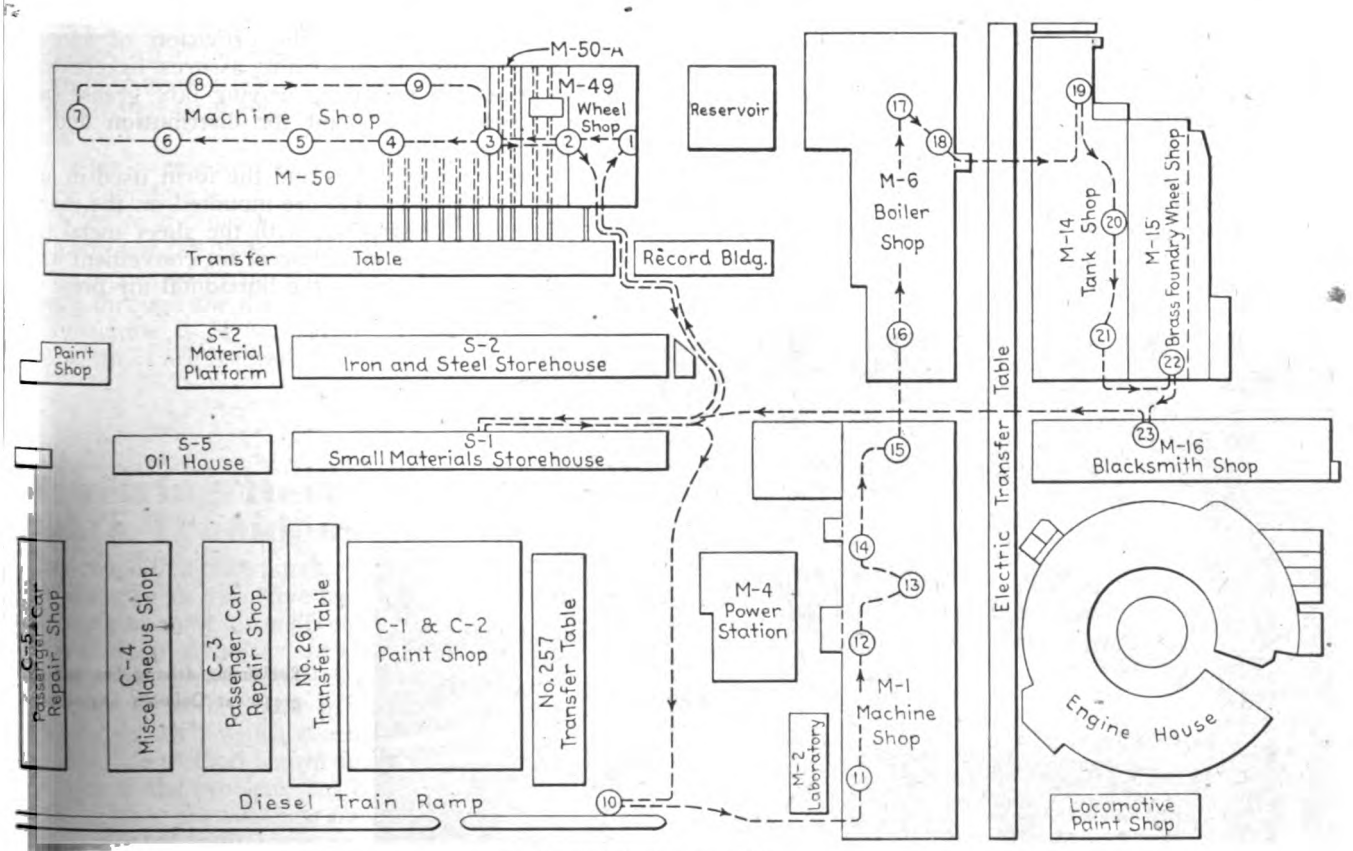
train ramp at 7:30 a. m., picks up orders at Boxes 11, 12, 13, 14 and 15 in building M-1; Boxes 16, 17 and 18 in building M-6; Boxes 19, 20, 21 in M-14; Box 22 in M-15 and Box 23 in shop M-16, and delivers these orders to building S-1 to be filled by the stores department forces. Materials supplied on orders from the previous trip are picked up and distributed, as required to Boxes 10 to 23, inclusive, the Chore Boy making a complete round trip once each hour.

One 10-ton gas-electric elevated-platform truck No. 3 is assigned to the wheeling and stripping shop. This lift truck is used exclusively for handling driving wheels from the stripping pit to the lye vat, and from the lye vat to the storage tracks; also from storage to wheel shop M-49 and from M-49 back to the wheeling shop, ready to be placed under the locomotives with the boxes and cellars in place; also wheels from storage to the stores department for shipment to outside points. The former method of handling wheels was by manual rolling. With the use of the high-low truck, mechanics and helpers can be kept on the job utilizing their talents where they are so badly needed. Also, in the past it was customary to use machinist helpers to scrape and clean the wheels. With this lift truck, the wheels are picked up and moved to the lye vat where the cleaning is done much more quickly, thoroughly and without hand labor.

A three-ton gas-electric crane No. 4 is assigned to M-50 and blacksmith shop M-16. It is necessary to move crank pins and other heavy castings such as crossheads, cylinder heads, valve heads, etc., from the stores department to the machine shop. Formerly men were sent to the stock piles to lift this material out and load it onto trailer push wagons and trucks by manual labor. The power crane truck now handles all such items on material-move orders and instructions from the material supervisor, and also handles heavy items to and from the various departments and repair points throughout shop M-50 and the stripping department which cannot



Typical material delivery station—Box 12 in the machine shop



Small materials storehouse, S-1

Box 1—Driving-wheel shop, M-49
Box 2—Stripping and wheeling shop, M-49
Box 3—Finishing and firing-up shed, M-50-A
Boxes 4, 5, 6, 7, 8 and 9—Machine and erecting shop, M-50
Box 10—Diesel-train ramp
Boxes 11, 12, 13, 14 and 15—Machine shop, M-1
Boxes 16, 17 and 18—Boiler shop, M-6
Boxes 19, 20 and 21—Tank shop, M-14
Box 22—Brass foundry and wheel shop, M-
Box 23—Blacksmith shop, M-16

Shop locations and material delivery stations or boxes at the Chicago shops of the C. & N. W.

be handled by the lift trucks, such as driving rods, stoker screws, pistons, reverse shafts, etc.

A three-ton capacity gas-electric lift truck No. 5, together with fifty Style I steel lift truck skid platforms, are assigned to the blacksmith shop M-16. As locomotives are stripped, spring rigging and brake rigging are placed in the steel skid boxes and moved to the blacksmith shop for repairs. After it is repaired, this material is placed back in the skid boxes and moved to the spring-rigging department where it is assembled ready to be placed on the locomotives. It is then moved from the spring-rigging department to the locomotive by one of the lift trucks assigned to M-50. All other forgings in the blacksmith shop are placed in skid boxes and moved by this lift truck instead of being moved on push carts and hand trucks by manual labor.

The electric-battery lift-truck formerly assigned to the blacksmith shop was inadequate because of its being a battery-operated machine which could not leave the blacksmith shop over the rough roadway and was not always available for service owing to the frequent necessity of putting it on the charging line. This battery lift truck, along with the necessary skid boxes for interdepartment moves, has been assigned to shop M-1 and boiler shop M-6.

A three-ton gas-electric high-low truck No. 6, along with the necessary skid boxes, is assigned to shop M-50 for movement of material between shop M-1 and M-50 and the stripping shed. A great number of castings are machined in shop M-1 such as bull rings, crossheads, crosshead shoes, back valve heads, driving boxes, cylinder heads, etc., for locomotives undergoing repairs. These items are placed on skids and moved by this power truck in place of hand trucks and push carts. The truck also moves heavy items that are on shop orders for outside points from M-1 and M-50 to the storehouse S-3 for shipment. It also handles finished and repaired items on skids from the machine side of M-50 to the erecting floor.

A second three-ton gas-electric high-low truck No. 7 is assigned to the brass foundry and wheel shop M-15, and to tank shop M-14 for interdepartment moves, and operates between M-1 and M-50. This machine moves roller-bearing parts to the point of assembly from the wheel shop and the tank shop; moves all brass, such as rod bushings, shoes and wedges, crosshead shoes, etc., in skid boxes to M-1 and M-50; and returns from M-1 and M-50 to the brass foundry with scrap brass and shavings which are placed in skid boxes at stations throughout M-1 and M-50. It also handles heavy items of material from the stores department to M-14 and M-15.

One large crane truck, which cannot be used in any shop buildings because of its size, is now used exclusively for unloading and loading of wheels at the tank wheel shop from wheel cars for shipment to outside points.

There are also two large-bed lift trucks for extra heavy parts. Special skids have been made for one truck which is assigned to the stripping pits in M-50-A. All material, such as motion work, crossheads, pistons, casings, spring and brake rigging, boiler mountings, air equipment, driving boxes, etc., are moved from the locomotives in skid boxes and this truck works between M-50-A and the lye vat and is used for delivering material from the lye vat to the various departments in M-50. The other lift truck is assigned to the lower end of M-50 for handling boosters, stokers, etc., and other heavy items on the erecting floor.

One International tractor is used for hauling trailers loaded with bar stock from the iron racks to the blacksmith shop and machine shop; front ends and ashpans from M-50 to M-6; wheel centers from the stores department to M-1 and from M-1 to M-49, and other heavy items of material.

Grease Reclamation

One corner of the grease reclamation room at the Oelwein, Iowa, enginehouse of the Chicago Great Western, is shown in the illustration. The provision of adequate equipment and orderly procedure assures exceptionally favorable results in preparing driving box grease cakes and pin grease at this point for distribution and use throughout the system.

Two vertical air cylinders and the form used in making driving-box grease cakes are mounted on the channel at the left in the illustration, with the sheet metal table and paper roll immediately adjacent for convenient wrapping. Close to this table is the horizontal air press and

Reclaiming driving box and pin grease at Oelwein enginehouse

die used in forming pin grease which comes through the die in long strings, is cut off and drops to the sheet-metal pan from which it can be packed in light wood boxes.

The mandrel, shown at the extreme right in the illustration, is made of a scrap driving axle turned down in five sections for use in straightening the various sizes of perforated driving box cellar plates. These sizes include 9 in. by 12 in.; 10 in. by 12 in.; 10½ in. by 12 in.; 11 in. by 14 in.; and 13 in. by 14 in.

Old driving-box grease cakes shipped to Oelwein from all points on the system are reclaimed by trimming off the dirty grease and using the remaining clean grease for reworking into grease cakes and pin grease. All grease, both new and to be reclaimed, is stored in easily accessible steam-heated lockers so it will be sufficiently pliable to permit being formed or forced through the dies without the use of excessive pressures in the 18-in. air cylinder for the grease-cake press and the 14-in. air cylinder for the pin-grease die.

Perforated plates removed from the incoming grease cellars are cleaned in the lye vat and straightened on the five section mandrel ready for re-use. In order to assure a thin layer of grease between the perforated plates and the main journals of newly packed driving-box cellars, a priming plate is placed in the bottom of the grease-cake press and the perforated plate on top of that. The sides of the press are brushed with water to prevent sticking; about one-quarter of a cake of new grease is applied in the press, with a canvas square on top to prevent sticking to the follower plate; air pressure is applied in the 18-in. cylinder which forces the follower plate into the press and forms the grease cake; the follower plate is withdrawn; a smaller air cylinder under the table pushes the grease cake up out of the press; the priming plate is pulled off leaving a regular thin pattern of grease on top of the perforated plate; excess grease squeezed out during the pressing operation is cut away; and the grease cake with perforated plate in place is ready for packing and shipment.

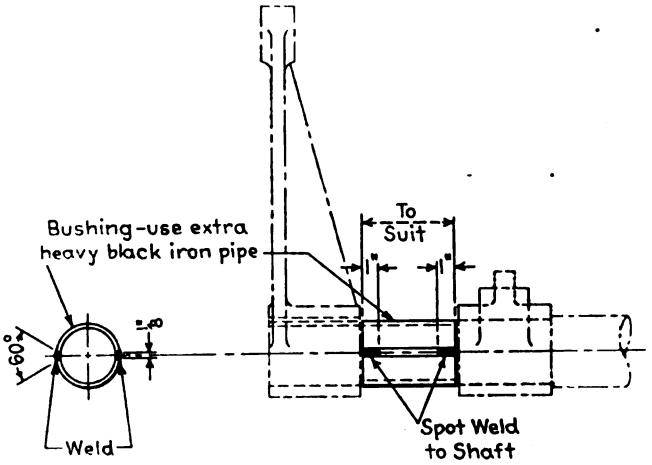
The pin-grease forming machine also consists of double-acting cylinders which operate horizontally. The grease is placed in the nearer cylinder which has a die drilled with holes of the proper size at one end and a close-fitting piston, operated by the tandem air cylinder, which forces grease through the die. Most of the pin grease made in this machine is 5/8 in. and 7/8 in., although some 1-in. grease sticks are required for old style rod grease cups.

Renewing Reverse-Shaft Trunnions

Some roads that have purchased large steam power within the past year or two have found that the first time these locomotives come through the shop for general repairs the trunnions of the reverse shaft are worn out of round and must be turned. There are instances where a shop is not equipped with a lathe of sufficient capacity to swing the reverse shaft with the arms attached. Where this is the case the method shown in the drawing is a possible solution of the problem, but one of two things must be done. Either the bushings must be applied to the shaft before it is too badly worn, in which case the bore of the reverse shaft bearings must be increased, or the arms must be removed from the shaft and the trunnions turned down to take the bushings.

The application of the bushings is a simple process. They can be made from pipe, bored and turned to fit. They are then split and clamped to the shaft, welded as shown, and the weld filed down to a smooth surface.

The method shown is used at the Beech Grove, Ind., shop of the New York Central. At this shop, which has



The application of the bushing and the welding method is clearly shown by this drawing

lathes of large capacity, the trunnions are first turned and a bushing is applied of such outside diameter as will suit the present bore of the reverse shaft bearings.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Water Level Determination

Q.—When determining the water level of a locomotive, it is our practice to obtain the height of the crown sheet by the use of a hose and two water glasses filled with water. One glass is placed against the under side of the crown sheet, the hose is passed through the firedoor hole and the other glass laid against the backhead and slowly raised until water runs out of the glass against the crown. The level of the water in the glass against the backhead determines the height of the crown sheet. This is done after the engine has been leveled both longitudinally and crosswise. The question has been raised as to the accuracy of this method, especially with regard to the possibility of air bubbles being pocketed in the hose. Can an air pocket in the hose be detected?—F. I. K.

A.—Air pockets in the hose can be detected by filling the hose with water, bringing the glass tubes side by side and observing the water level. If it is not the same in both tubes there is an air bubble or other obstruction in the hose. In preparing a hose for this purpose, run water through the hose for a short time until you know the hose is wet all the way through. Then fill it and keep pouring a little water into one end, running the water out at the other end. Work the hose a little and then make the test.

Use of Exhaust-Steam Injectors

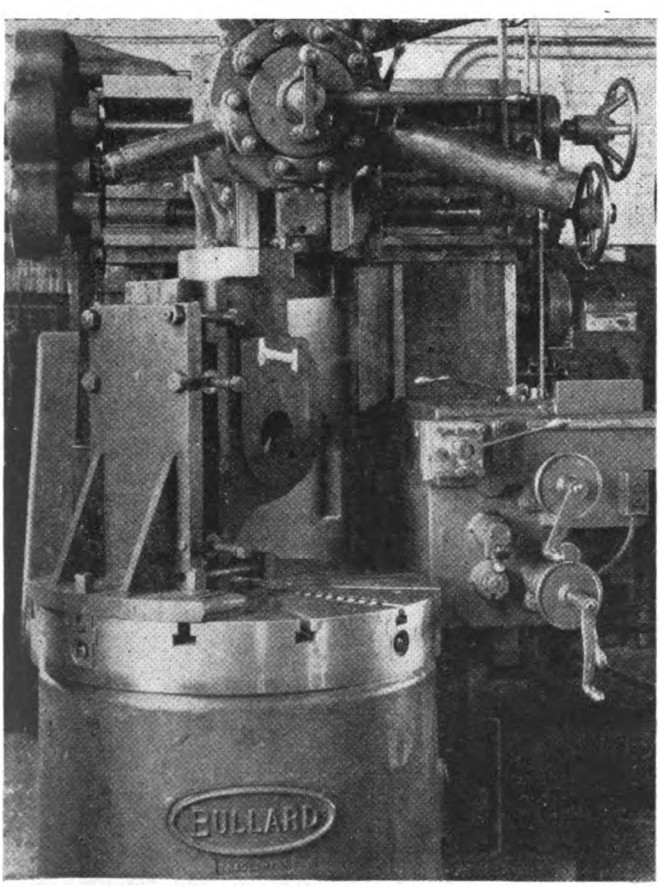
Q.—What advantages has the use of an exhaust-steam injector in place of the live-steam injector with respect to boiler maintenance?—M. I. R.

A.—The exhaust-steam injector delivers the feedwater at temperatures averaging 200 deg. F., thus improving the circulation of the water in the boiler. Improved circulation results in more uniform temperatures which in turn reduces the stresses set up in the boiler. These stresses manifest themselves in leaky and broken staybolts, warped and cracked firebox sheets, and the deterioration of the water surfaces of the boiler in general. While the exhaust-steam injector is not the cure-all for these troubles, the fact that it does improve circulation by introducing the feedwater at high temperatures, is bound to reflect itself in the maintenance of the boiler.

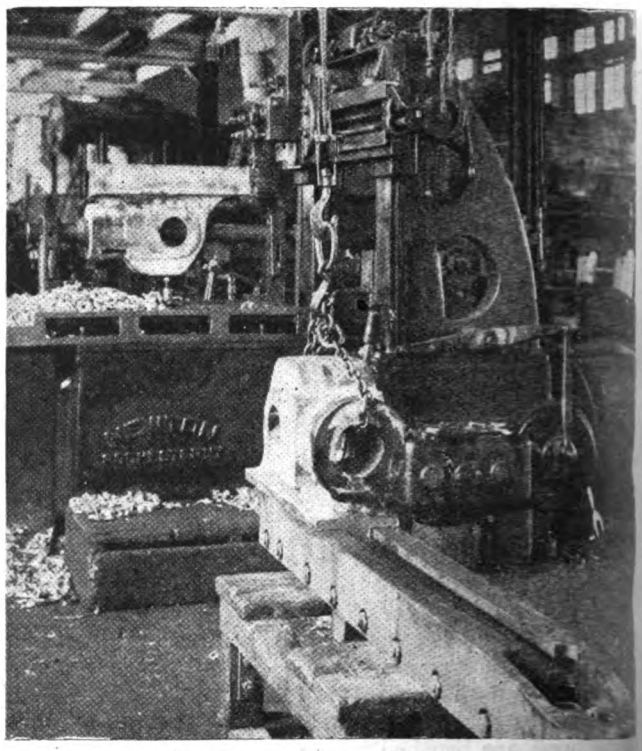
Machining Multiple Bearing Crossheads

Heavy repair work on Chicago Great Western locomotives is done at the back shop, Oelwein, Iowa, but the enginehouse at that point is equipped to make Class 5 repairs. As practiced on this railroad, these constitute thorough overhauling of all the wheels, driving boxes and motion work. A new Bullard 42-in. vertical turret lathe recently installed in the Oelwein enginehouse greatly facilitates this work especially when equipped with necessary holding jigs and fixtures for some of the awkward locomotive parts which have to be machined.

New crossheads, for example, are generally finished at the Oelwein back shops, but if it is necessary to renew a piston rod for any reason at the Oelwein enginehouse, this involves reboring the taper fit in the crosshead. Particularly in the case of underhung multiple-bearing crossheads, it is not easy to set the crosshead up accurately on the boring machine table and at the same time rigidly enough so that a smooth cut can be taken.



Bullard 42-in. vertical turret lathe machining crosshead at Oelwein enginehouse



Multiple-bearing crosshead being machined on crank planer and fitted to the guide

To facilitate this work a special jig has been built which is in reality an angle bracket made of 2-in. steel plate, with a base 24 in. long by 10 in. wide at the widest point of the curved outer side. The vertical plate 14 in. wide by 29 in. long is welded to the base plate, being set accurately at an angle of 90 deg. to the base and stiffened in that position with two 1-in. angle brackets as shown in the illustration. The jig is fabricated by electric welding and drilled for holding bolts.

It is obvious that a crosshead bolted to this fixture will have the center line of the piston bore accurately vertical in one plane and can be easily adjusted to be vertical in a 90 deg. plane by means of the holding bolts. Slots in the base of the jig permit adjustment on the machine table so that the center line of the piston-rod bore can be easily adjusted to coincide with the center line of the machine table.

The particular job illustrated consists of facing the boss with a small round-nose tool supported in one of the turret tool holders. The boss is also turned with the cutting tool held horizontally in the same turret head. For boring the piston-rod fit, the short boring bar is used, the head of the machine being set to a taper of ¾ in. per foot. The table speed is set for23 r.p.m., and the roughing feed is .245 in. per revolution. For finishing, this feed is reduced to .083 in.

On a crosshead of the size illustrated, designed for use on the 2-10-4 type locomotives of the Chicago Great Western, about 3½ hrs. are required for boring the piston rod fit, one-half of this time being setup time. The accuracy of the fit and smoothness of the bore is such that subsequent grinding or lapping of the piston rod end in the crosshead is not required.

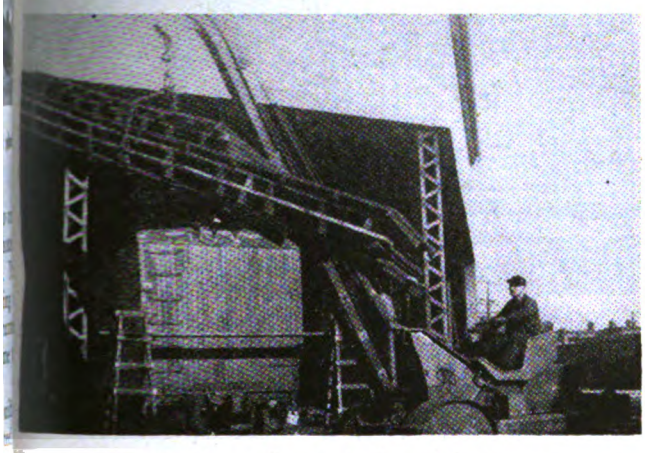
With the Car Foremen and Inspectors

The Mechanical Handling of Car Material*

By J. T. Crake†

The purpose of this paper is to set forth what can be done in the efficient handling of car material at a small car shop or rip track by the use of several devices which have proved of material assistance.

At larger shops, the railroads do not hesitate to install all modern devices, which they no doubt find economical. However, the trend of opinion among railroad officers



Handling heavy floor racks by mobile crane

seems to be that the volume of material handled in the smaller shops or on rip tracks does not justify a large expenditure for any material-handling devices. This I believe is an error. However, it is necessary for the individual car foreman to convince the management of the efficiency of the various devices available.

We found that the use of a simple roller conveyor for unloading lumber not only has reduced unloading costs considerably, but has lightened manual labor by eliminating the carrying of heavy items, such as large oak timbers, etc.

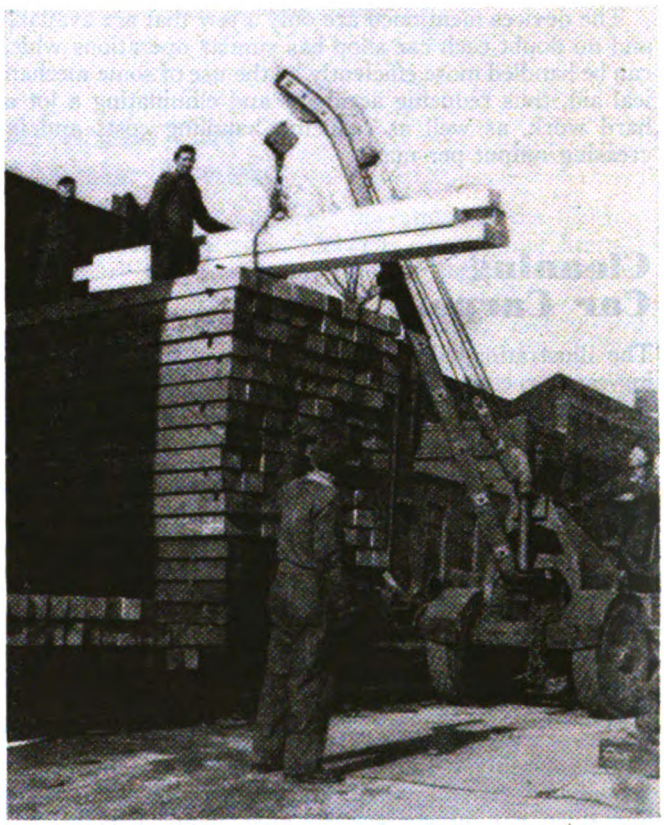
These roller conveyors are efficient in the unloading of tongue-and-groove lining, 16 and 18 ft. long, as they can be spotted so that the material is rolled right on the pile, eliminating quite a bit of walking which, in turn, reduces the unloading time. We have computed that the unloading of one carload of 18-ft. lining by the old hand method required each man to walk approximately seven miles, during which walk it was necessary to carry approximately 90 lb. on his shoulder. The use of this roller conveyor eliminates practically all of this walking and carrying.

In the wood mill, we found it expensive to handle lumber from one machine to another on the old-style trucks, particularly heavy items, such as large oak and other timbers. If any appreciable amount was run at one time, it took several men to move the trucks from one machine to another. By the use of a hydraulic hand-operated lift truck, one man can now move this stock from machine to machine with little or no effort, whereas it formerly took from three to four men to perform this same operation.

We have also found the mobile cranes invaluable in speeding up the delivery of material, as well as lightening the burden of handling various kinds of material in our shop, rip track and material yard. We formerly used six men in unloading heavy timbers, such as sills and plates, and this was dangerous work. With the mobile crane and three men we now unload six sills at one time. The same condition exists in the delivery of these sills from the stock pile to the wood mill. It formerly required six men to carry one of these sills to the mill, whereas with the mobile crane the operator and one man deliver six sills at a time.

The use of these mobile cranes in the handling and loading of scrap iron has also proved economical. We load all scrap in one-trip steel drums, storing the scrap in these drums, and when the scrap is loaded we merely lift these drums into the car and dump the contents. By this method, we load from 300 to 800 lb. on each lift.

We also find the mobile crane invaluable in cleaning the shop. As a refrigerator line, we have a large accumulation of scrap paper, felt and small pieces of wood, all of



The crane lifts six heavy timbers at one time

* Abstract of a paper presented before the January 16 meeting of the Car Department Association of St. Louis.

† The author is labor gang leader of the St. Louis Refrigerator Car Company.

which is light but difficult to handle and dispose of. Our present method is to use scrap boxes about 5 ft. wide and 9 ft. long, which are set at strategic points throughout the shop. The boxes are filled with the rubbish as it is taken from around the cars. The mobile crane then picks the box up by the use of chains hooked in the four corners of the box. The crane operator takes the box to the rubbish car, where two chains are disconnected and the boom raised, permitting the contents to fall into the rubbish car. This is all performed by the crane operator without any assistance.

Truck Work Facilitated by Mobile Cranes

We also find these mobile cranes assist us materially in setting up trucks, handling mounted wheels, and loading and unloading of unmounted wheels. I might add that these items all are heavy and the burden on the men is lightened considerably. It is possible to set up an entire truck without the men doing any lifting whatever, as all parts are lifted into position by the crane boom.

We also use the mobile crane for moving cars to the exact location desired, and for the delivery of all heavy material directly to the car.

The original cost of some of these devices may appear to be large. However, when consideration is given to their many uses it is obvious that they are economical. We have computed that the cost of operating one of these machines, including depreciation and repairs, is about equal to the wages of one laborer. It is obvious that they can do more work than one man. In fact, it has been our experience that they are capable of performing the work of several men.

We also found the use of these mobile cranes eliminated quite a number of accidents, especially mashed and broken fingers and toes. The savings realized by the prevention of accidents assists materially in defraying the expense of one of these machines. This is also true of other material handling devices.

The devices mentioned are only a few that are available and no doubt each car shop has similar operations which can be handled more efficiently by the use of some mechanical aid, thus reducing accidents and eliminating a lot of hard work, as well as reducing handling costs and increasing output per man.

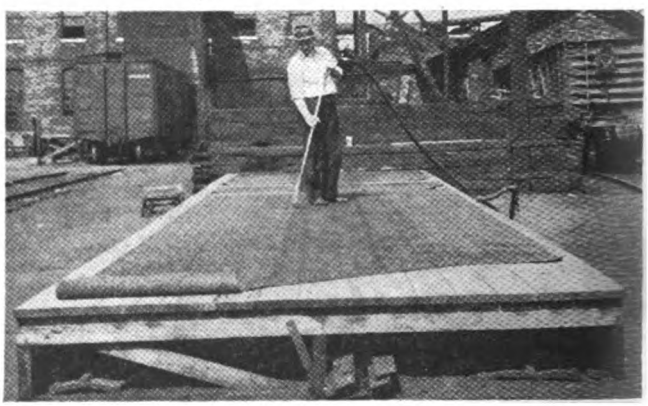
Cleaning Car Carpets

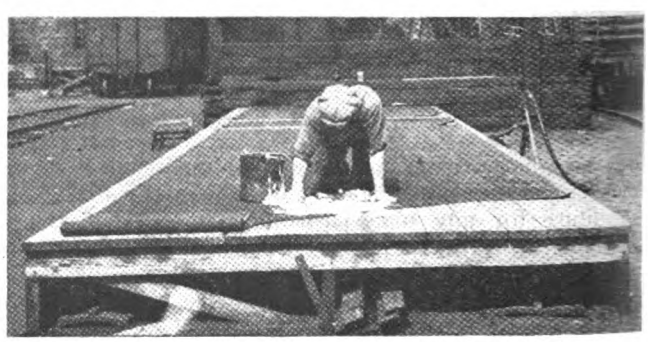
The illustrations show the operation of cleaning a dining-car carpet preparatory to replacing it in a diner at the 47th Street, Chicago, coach shops of the Chicago, Rock Island & Pacific. The cleaning platform is a wooden structure about 24 in. high by 11 ft. wide and 60 ft. long. In accordance with usual practice, air is piped from the shop line to a point about midway along one side of the platform. The air pressure varies somewhat, but is usually about 70 lb., air being conducted to the 4-ft. pipe section with expanded nozzle, held by the operator, through a rubber hose of suitable length.

All car-servicing operations are subject to change under present arduous conditions in railway coach shops, but, in general, carpets of Rock Island cars are given three classes of cleaning: once a week, the carpets are removed and thoroughly blown on the platform illustrated; approximately twice a year the carpets are not only blown but given a light surface cleaning; when cars are received at the shops for general repairs, the carpets are blown and thoroughly washed and renovated before being returned to the cars.

For the weekly blowing operation, all dust and dirt in the carpet is thoroughly loosened by inserting the air pipe between the carpet and the platform and working the air jet back and forth under the carpet, first on one side of the platform and then on the other. Any loose dirt remaining on top of the carpet is then removed by light blowing from the top as shown in one of the illustrations. This job usually requires about two hours, or two men can do the work in one hour.

For the semi-annual cleaning, the carpet is first blown as described. The carpet is then gone over carefully to remove all gum and grease spots using a combination of benzine and ether in the proportion of four or five ounces of ether to a gallon of benzene. The benzene loosens the gum which can be removed by scraping and the ether





Blowing and light washing a dining-car carpet at the Chicago coach shops of the C. R. I. & P.

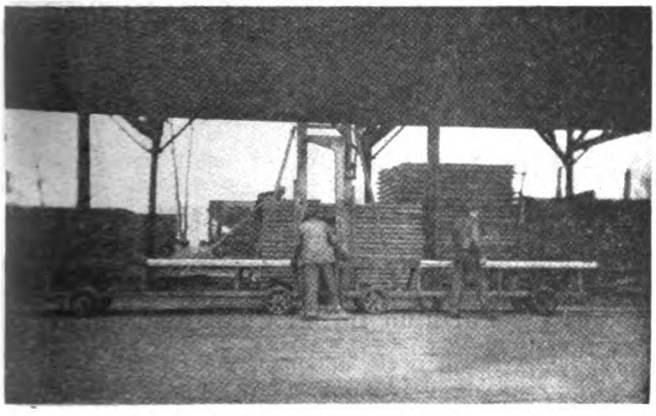
dries up grease spots which would otherwise be left. A special carpet-cleaning solution, developed on the Rock Island, is applied with a sponge and quickly brushed off to clean the surface nap without wetting the main weave or warp. This operation takes one man four hours or can be speeded up in proportion by using two men.

For major cleaning when the cars are taken into the shop for general repairs, the carpet is blown and gum and grease spots removed on the carpet blowing platform illustrated. The carpet is then taken to the upholstery department in the shop, stretched to the required standard length and tacked to the floor, ready for thorough washing which involves wetting the carpet all the way through, including the warp, and which would cause shrinkage without tacking the carpet to the floor. For this heavy washing, a solution of ¼ lb. of borax added to 24 bars of ivory soap cut in flake size is used and the mixture boiled until dissolved. The solution then stands until it becomes a heavy jelly.

This jelly is scrubbed on the carpet with a brush and scraped off with a 6-in. by 12-in. sheet metal squeegee, the operation being repeated as many times as necessary to clean the carpet which is then sponged and scraped until all traces of soap are removed. The carpet is allowed to dry thoroughly in its stretched position and is then brushed with a stiff rice brush which raises the nap and produces a uniform color. The carpet is then ready for reapplication in the car. A half section of dining car carpet, 9 ft. wide by 30 ft. long, can be scrubbed in approximately 2½ hr. by this method. The function of the soap in the scrubbing solution is, of course, to wash the nap and warp thoroughly and the borax is used to restore the sheen to the fabric. No attempt is made to dye carpets which become faded as this would destroy the pattern.

Sawing Lumber At the Storage Pile

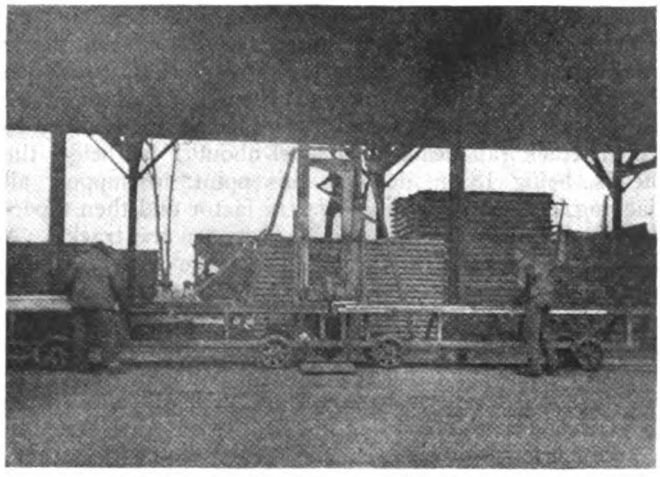
Storage sheds for freight-car flooring at the Birmingham car shop of the Southern are located adjacent to the working tracks but at a distance of approximately 1,000 ft.



A length of flooring being sawed as the helper prepares to feed another length to the operator

from the planing mill. It was formerly necessary, when flooring was to be cut to length, to load shop trailers with flooring, move it to the planing mill, saw and reload the flooring on the trailers and move the trailers to the work track. The handling involved in preparing a load of flooring has been reduced to a minimum since a saw has been mounted on a moving carriage which runs on tracks paralleling the storage shed. Now it is necessary only to locate the saw carriage opposite the pile of flooring to be cut and to connect the electric-motor power cable in one of the electric outlets installed at intervals along the entire length of the storage shed. Mill-length flooring is fed by a workman on the storage pile to the two men at the saw, one of whom acts as a feeder and the other as saw-operator and loader. There are guide stops on the carriage for the various lengths required. As the rough flooring is cut to lengths, it is slid off of the end of the carriage onto the shop trailers which move it to the required locations.

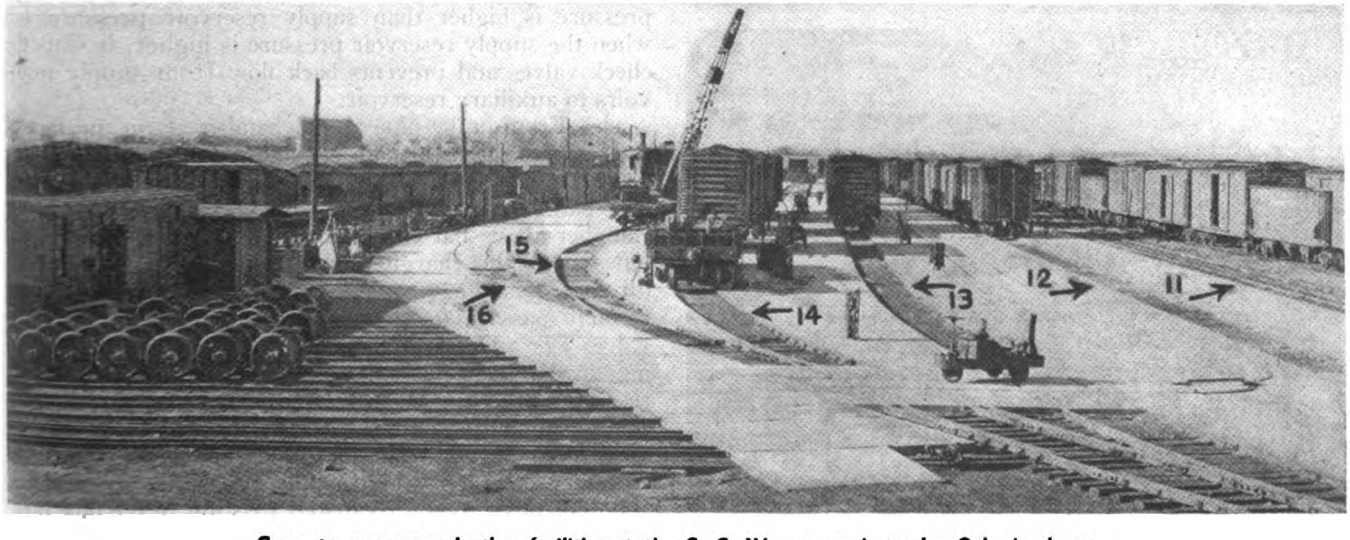
In addition to reducing the actual handling of this type of car material to a minimum the installation considerably reduces demands upon the services of shop tractors, ties up fewer trailers and cuts down tractor and trailer mileage on each load of flooring handled.



The feeder is receiving floor plank from the man on the storage pile —The saw-operator at the left is sliding a finished piece into a shop trailer

Oelwein Car Repair Track

In the fall of 1943, car repair operations at the Chicago Great Western rip track, Oelwein, Iowa, were literally lifted out of the cinders and mud by the installation of



Concrete runways and other facilities at the C. G. W. car repair tracks, Oelwein, Iowa

concrete runways between all repair tracks and the well-planned line-up of small shop buildings and servicing facilities provided along the northeast side of the repair track area. One unusual feature of these runways, which has demonstrated its value since the original installation, is the fact that the concrete was carried all the way to repair-track rail heads at a level about 1 in. below the heads, being 18 in. deep at this point, to support all jacking loads with an ample safety factor and then tapering in thickness to 5 in. midway between the tracks. A total of about 3,100 cu. yds. of concrete were required for this job.

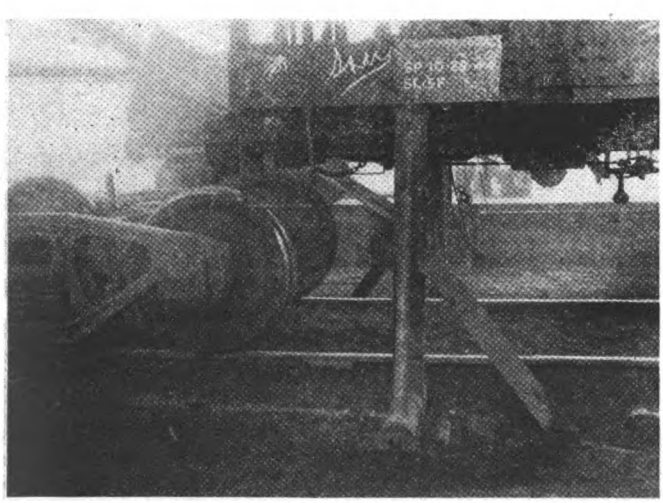
Referring to the illustration, the general arrangement of the yard, which involves six tracks with an average length of about 500 ft., is apparent. Tracks 12 and 13 are reserved for light repairs and Tracks 14 and 15 for heavy repairs. No. 16 is a run-around track for rail equipment, including the steam-operated crane, and it will be noted that the concrete is carried across this track flush with the rail heads so that motor equipment and material delivery trucks can use this roadway and cross the rails at will. Similarly, a standard-gauge material track was left in the concrete roadway between Tracks 12 and 13. The concrete is carried across the yard as far as midway between Track 12 and Track 11, which is the yard transfer track.

An important additional facility is the provision of 14 acetylene and air stations, and electric welding facilities, conveniently located down the middle of the runway between Tracks 13 and 14. A series of wheel-storage tracks is located at the nearer end of the yard with a single cross track and small turntable for delivering wheels to the material delivery track between Tracks 12 and 13.

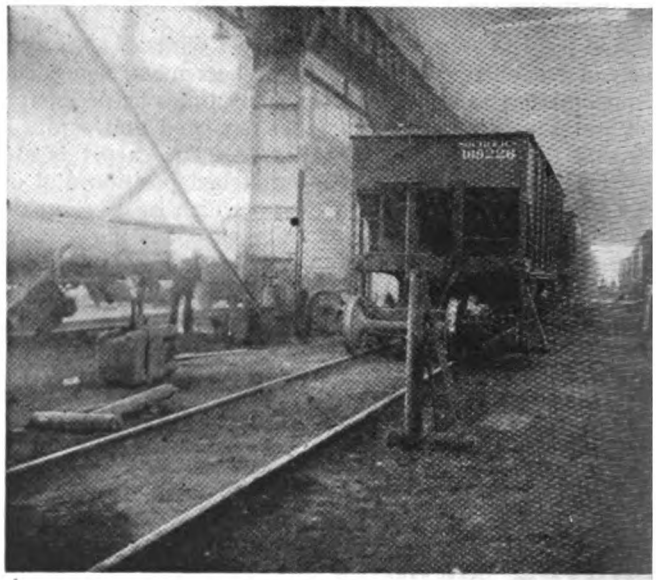
A force of 43 car men and helpers is employed at the Oelwein car repair yard and the present output is about 25 light repairs and two heavy repair cars a day.

Shop Trestles

Permanently-located car trestles are used in the Birmingham car shop of the Southern along all of the regular working tracks. These trestles are built of scrap superheater tubes and bar iron welded together to form a post section which operates on a hinged floor section. In the raised position the posts are held in place by a supporting arm which is pinned to a bracket on the upright. The trestle posts are lowered by removing the pin and releasing the supporting arm from the bracket; when lowered they do not interfere in any way with the shifting of cars into or out of the shop.



Side view of one of the trestle posts



The trestle posts in the foreground are shown in both the upright and lowered positions—All cars in the background are set up on trestles so that trucks may be worked

Air Brake Questions and Answers

HSC Equipment on Passenger Cars and Diesel A and B Locomotive Units Functioning of Parts on Initial Charging

270—Q.—What is the action of the D-22-BR control valve during initial charging?. A.—The auxiliary and emergency reservoirs are charged in the same manner as described for the D-22-ER control valves on the locomotive. In addition, the supply reservoirs are charged from two sources: (a) from auxiliary reservoir through the release slide valve, chamber *D*, port *r* in the release slide valve, passage *rl* in the seat, past ball and flat check valves to passage *6* and the supply reservoirs. Spring *84* is overcome and check valves *74* and *87* are unseated, permitting this charging flow as long as auxiliary reservoir pressure is higher than supply reservoir pressure, but when the supply reservoir pressure is higher, it seats the check valves and prevents back flow from supply reservoirs to auxiliary reservoir.

(b) From brake pipe air in chamber *A* on the face of the service piston through passages *1c* and *1d*, the cavity in the limiting valve slide valve *136* passages *1k* and *1j*, past ball check valve *74a* and flat check valve *83a* to the chamber above flat check valve *87*, where the flow combines with the charging flow from auxiliary reservoir through passage *rl*, thence to the supply reservoirs through passage *6*. Spring *89a* is overcome and check valves *74a* and *73a* are unseated, permitting this charging flow as long as brake pipe pressure exceeds supply reservoir pressure. When supply reservoir pressure becomes higher it seats the check valves and prevents back flow from supply reservoirs to brake pipe. Thus the auxiliary emergency and supply reservoirs are charged simultaneously to approximately existing brake pipe pressure.

271—*Q.—What part does the brake valve on the A nit play in this operation?* A.—The brake valve on the power unit maintains charging connections for all HSC rake application handle positions so that the reservoirs re continuously charged in this manner during HSC lectro-pneumatic brake operation. Therefore, the sys-m is constantly recharged when the HSC electro-pneu-atic brakes are applied so that the supply for brake ap-lications is always available and adequate.

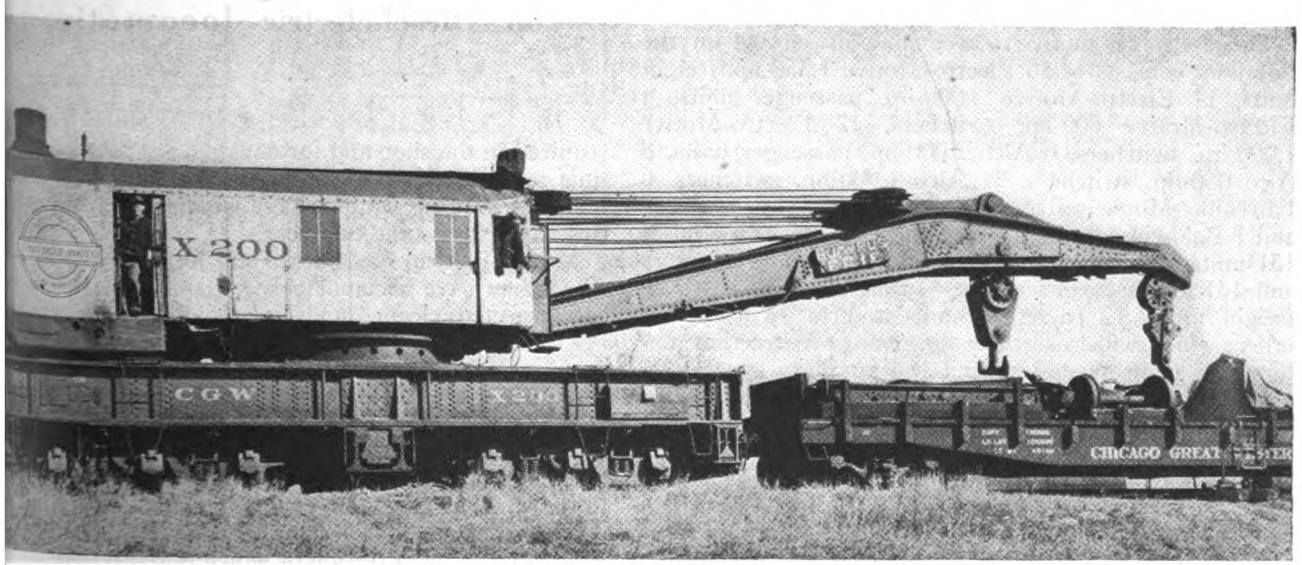
272—*Q.—How does the FS-1864 relay valve function uring initial charging?* A.—At the FS-1864 relay valve, upply reservoir air from connection *6* charges the cham-r around application piston and its pilot valve; pipe *16* open to the control valve, passages *16* and *16a*, past uble check valve to passages *8a* and *8* to the straight pipe, which is open at the 21-B magnet valve exhaust. his connects diaphragm chambers *P, N. K* and *A* of the lay valve through passages *19, 18, 17* and *16a*, to the agnet portion. With the *M, L* and *H* magnets de-ener-zed, passage *19* is connected past upper magnet valve *1b* and choke *138* to passage *15*; passages *18* and *17* st lower magnet valves *161* and *161a*, and chokes *140* d *142* to passage *15*. Passage *15* is connected past un-ated supply valve and passage *16c* to passage *16*. As ssage *16* is connected to the 21-B magnet valve ex-ust the diaphragm cavities *P, N. K* and *A* are ex-usted and piston spring *42* holds the diaphragm assem-y released. All pressure is thus released from lever *43* hich floats freely, permitting the exhaust piston and its lve to remain open, releasing the air from chamber *F* d connected brake cylinders to exhaust *Ex*. Chamber *A* the switch piston is open to atmosphere. Spring *9*, erefore, releases collar *6* which disengages finger *20* om contacts *28* and *28a*, thus opening the car battery cuit to the relay cabinet.

273—*Q.—How does the continuous quick service valve nction during initial charging?* A.—At the continuous ick service valve, brake pipe air flows through strainer to piston chamber *A*, moving the piston *8* and attached de valve to its inner position on its seal. This piston ovement uncovers choke *3*, through which brake pipe charges through passage *2* to the quick service cham-r and piston chamber *B*. Owing to the restricted charg-g rate through choke *3* and the volume of the quick rvice chamber, chamber *B* will charge somewhat more slowly than chamber *A*, the greater pressure in the lat-ter meanwhile holding the piston in release position. As the quick service chamber and chamber *B* become charged to brake pipe pressure, the air pressures on the piston become balanced and the piston remains in release posi-tion of its own inertia. Thereafter, as long as the brakes are released, any small fluctuations in brake pipe pres-sure will equalize with quick service chamber pressure and maintain the piston and slide valve in release posi-tion. In this position no connections are made by the slide valve except brake pipe air from passage *1a* is pres-ent in slide valve cavity *h*.

Brake Application

274—*Q.—When brake application is made what parts function first?* A.—As explained under MS-40 brake valve, when a brake application is made, the self-lapping portion immediately builds up control pipe pressure cor-responding to the position of the brake valve handle. The air pressure developed in the control pipe, by the posi-tioning of the brake valve handle moves valve *4* of the *15-C* double check valve, closing the connection between the D-22-ER control valve and master controller. Con-trol pipe pressure builds up in chamber *B* of the master controller. Application diaphragm *18* is deflected to the right thus moving shaft *32* and contact levers *40* and *41*. As spring *24* is compressed, lever *41* first closes release contact, after which spring *32* is compressed and lever *40* closes application contact, thereby energizing the release and application wires, which are connected to application and release magnet valves of the *21B* magnet brackets on the locomotives and cars throughout the train. The armatures of the *21-B* magnets are pulled down against spring pressure beneath the valves. Release magnet valve *62* is seated, closing off the straight air pipe exhaust pas-sage *x* in each magnet bracket, and application magnet valve *34* is unseated, opening passage *6a* to *4b*. Auxiliary reservoir air thus flows to the straight air pipe, building up the straight air pipe pressure throughout the train. Cut-off valve *5* of the *21-B* magnet is held unseated by spring *17*, permitting the auxiliary reservoir air flow to passage *6a* as long as the auxiliary reservoir pressure exceeds approximately 75 lb., which is the value of spring *10*.

* * *



A Chicago Great Western 200-ton wrecking derrick

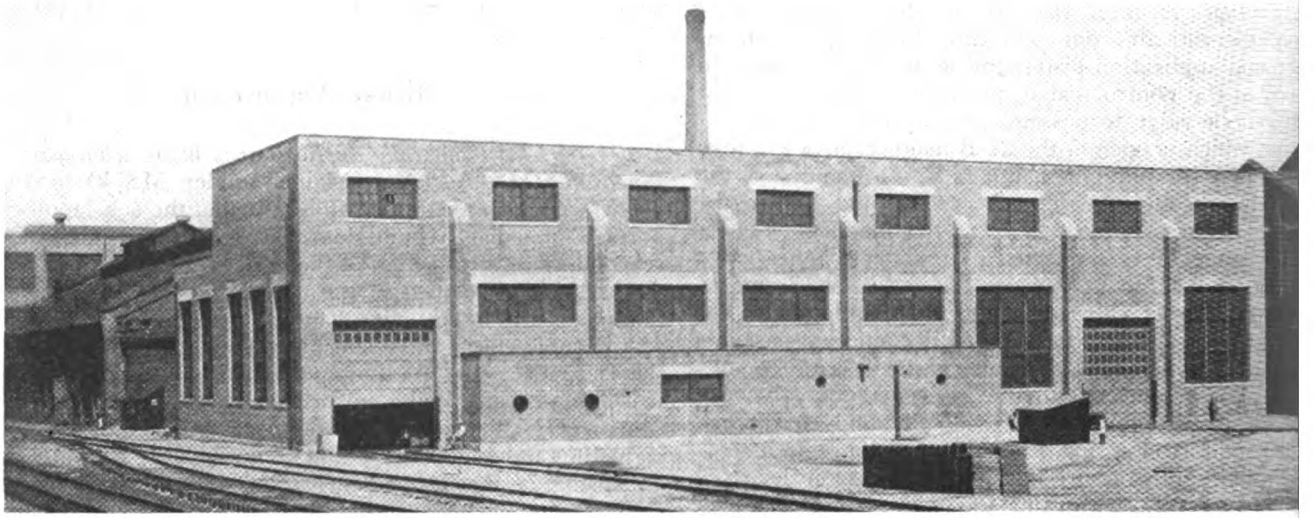


Fig. 1—The electrical shop for servicing of Diesel-electric motive power used by the Southern

Electrical Shop for Diesels

Part I

Southern installs new facilities at Atlanta, Ga., for overhaul and repairs of all traction motors and generators used on Diesel-electric locomotives

THE Pegram Shops of the Southern at Atlanta, Ga., have been equipped to maintain all traction motors and generators of the Diesel-electric power used on the railway. Mechanical maintenance is done in a section of the locomotive erecting shop arranged for that purpose and electrical work has been segregated in a separate new building adjoining the erecting shop. This article deals only with electrical shop facilities and electrical maintenance procedure.

Diesel-electric motive power now in service on the Southern consists of 56 Electro-Motive 1,350-hp. freight units, 11 Electro-Motive 2,000-hp. passenger units, 4 Electro-Motive 600-hp. switchers, 17 Electro-Motive 1,000-hp. switchers, 6 Alco 2,000-hp. passenger units, 8 Alco 660-hp. switchers, 21 Alco 1,000-hp. switchers, 6 Fairbanks-Morse rail cars, 1 Baldwin 600-hp. switcher and 1 Baldwin 1,000-hp. switcher. This makes a total of 131 units with 512 traction motors, 131 main generators and 131 auxiliary generators. In addition there are 20 freight units, 12 passenger units and 14 switchers on order, which will raise these figures to 696 traction motors, 184 main generators and 184 auxiliary generators.

The electrical shop is designed to perform all motor and generator repair work for the Southern system. The greater part of the shop is given over to Diesel-electric locomotive motors and generators, but one space including about 20 per cent of the floor area is equipped for small motor repair.

Spare motors, amounting to about ten per cent of the total are used for rotation in service to provide for time required in the shop and for emergencies. At the pres time rewinding is being done by the manufacturers, the shop is being equipped for winding and will assu this work some time this year.

Motors of road locomotives are brought into the sh when they have accumulated 200,000 miles, where th are inspected, cleaned and given such repairs as may needed. Motors of switching locomotives are overhau on four-year intervals. Accidental damage may of cou cause a motor to be brought in within this period. Arm tures are vacuum impregnated with insulating varn (Fig. 4) and baked, after which they are balanced bef assembly into a frame. Consideration is also being giv to the value of seasoning commutators.

The electrical shop is housed in a new brick buildi (Fig. 1), the main section of which is 162 ft. long and ft. wide. At one side a single-story extension, 18 ft.

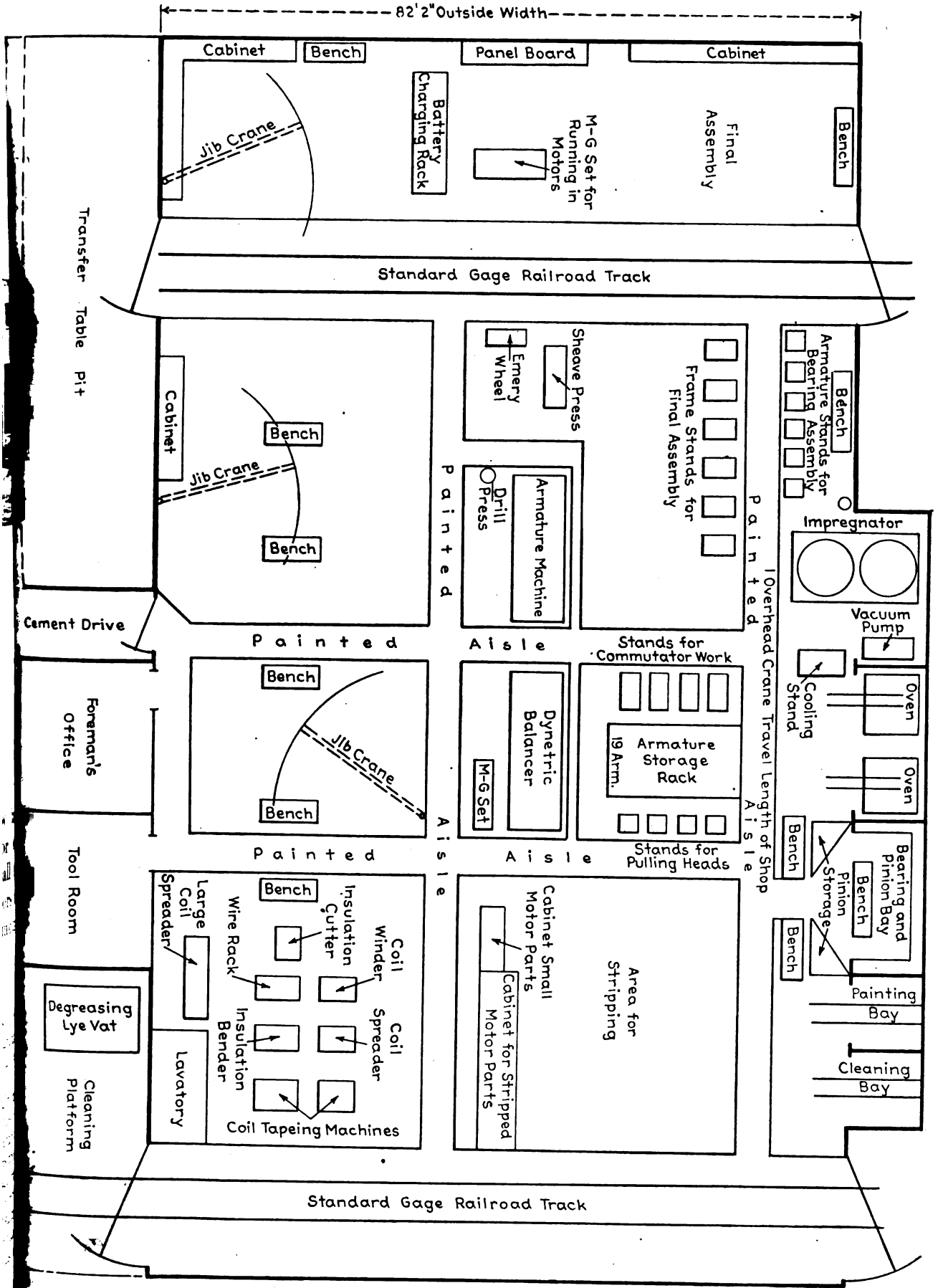


Fig. 3—A plan view of the electrical shop showing layout of the equipment

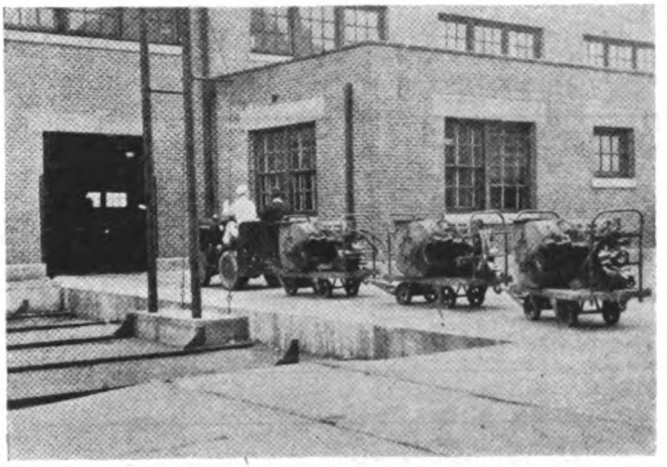


Fig. 3—Motors to be overhauled in the electrical shop are brought from the erecting shop on trailers drawn by a tractor

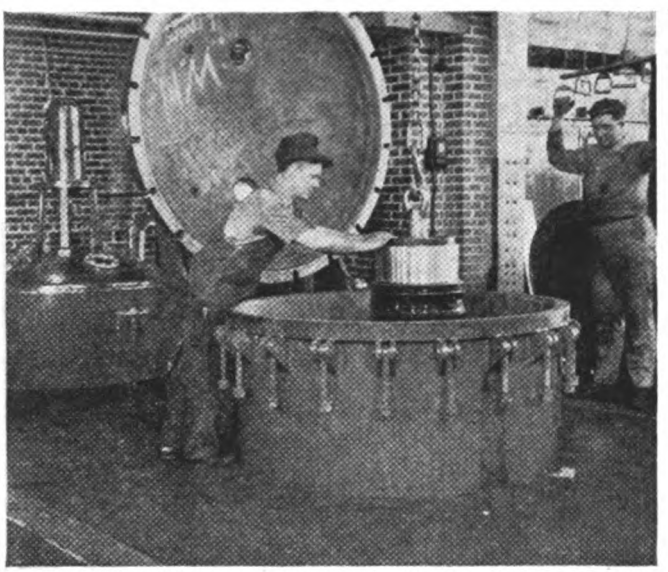


Fig. 4—An armature comes out of the impregnating tank

36 ft., houses the foreman's office and a tool and supply room in which supplies for current needs are carried. On the opposite side of the shop is another single-story extension about 9 ft. by 70 ft. which houses impregnating tanks, ovens, bearing overhaul facilities which do not require crane service, and painting and cleaning bays which need to be segregated from other shop operations. Exhaust fans at the back of the cleaning and painting bays further assure that cleaning fluid and paint fumes do not get out into the shop and serve to protect the men doing the work. Interior of electrical shop is shown in Fig. 5

SHOP RECORD CARD

Name of equipment ..... Manufacturer .....
Type or model No. ..... Serial No. .....
Requisition No. ..... Date received in shop .....
Locomotive No. ..... Received from .....
Reason for removal .....
Mileage this application .... Total accumulated mileage .....
Number of days in shop ..... Date shipped .....
Shipped to ..... How shipped .....
Approximate cost of repairs ..... Labor ..... Material .....
Job No. .....
For detail report
Refer to File ..... Serial No. .....

Fig. 6.—A record card of this kind is kept in the electrical shop for each traction motor

A ten-ton, floor-operated crane serves the half of the shop as shown in the upper half of the shop floor plan. Other locations where the lifting of heavy parts is

(*Continued on page 224*)

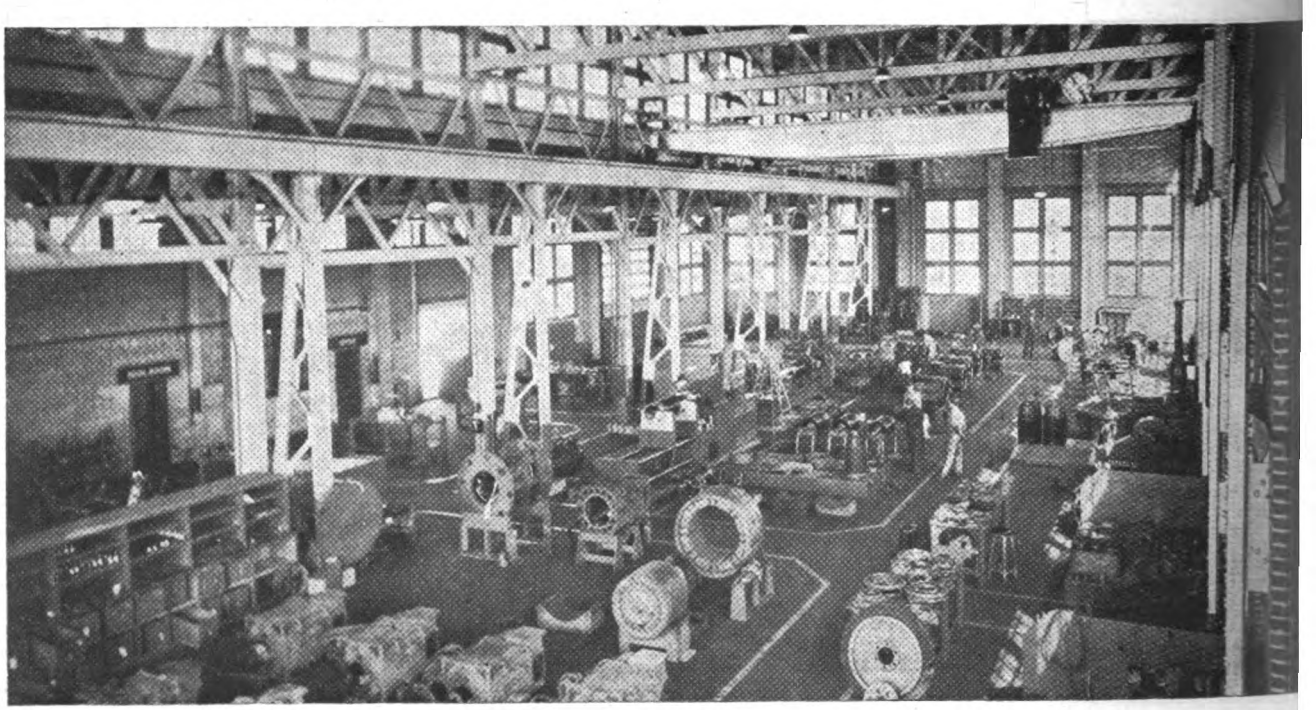


Fig. 5—Interior view of the electrical shop

Railroad Enginehouse Lighting

By William H. Kahler*

Use of 500-watt dust- and vapor-tight lighting units, and conduit coated with no-oxide grease type paint make a good and enduring lighting system

ENGINEHOUSE lighting presents several very difficult problems because the visual tasks involve poor contrasts and are in vertical planes on the sides of the locomotives. Excessive dirt from the smoke reduces lighting efficiency and the sulphur in the smoke creates a possibility of severe corrosion of metal parts. On the basis of these conditions, the following requirements apply to the lighting of an enginehouse:

1—Illumination on the sides of the locomotive should be adequate to enable workmen to service the equipment properly and quickly. The use of portable lights should be reduced to only those operations which are impractical to illuminate by general lighting.

2—Sufficient light also should be provided over the entire floor area of the stalls.

3—Lighting control should be arranged to permit illumination of any one stall, without lighting adjacent stalls.

4—Luminaires must be constructed and finished to resist the corrosive conditions.

5—Luminaires must be dust-tight to minimize light depreciation due to dirt and to protect the electrical parts from corrosion.

6—Luminaires should be easy to relamp and service.

The Luminaires

Two types of luminaires are required for the typical team locomotive enginehouse—one for the locomotive side lighting and the other for the areas at the ends of the stalls.

A special heavy duty concentrator was developed to illuminate the sides. This unit, illustrated in Fig. 3, consists of a steel housing, hinged cover, cast iron socket enclosure and an inner Alzak aluminum reflector. The socket enclosure is fitted with a cast swivel for rigid mounting from conduit at the required angle. A horizontal spread lens is mounted in the cover to spread the light more uniformly along the locomotive sides.

The unit for the ends of the stalls is of similar construction with steel housing, inner Alzak aluminum reflector and hinged cover (Fig. 4).

Both units are completely dust- and vapor-tight. They are finished with corrosion-resisting baked-on enamels to withstand the smoke fumes.

* Lighting engineer, Westinghouse Electric & Mfg. Company, Cleveland, Ohio.

Fig. 1—Typical enginehouse stalls illuminated with 500-watt heavy-duty enclosed units designed for enginehouse service—Note concentration of light on sides of locomotives as well as adequate general illumination

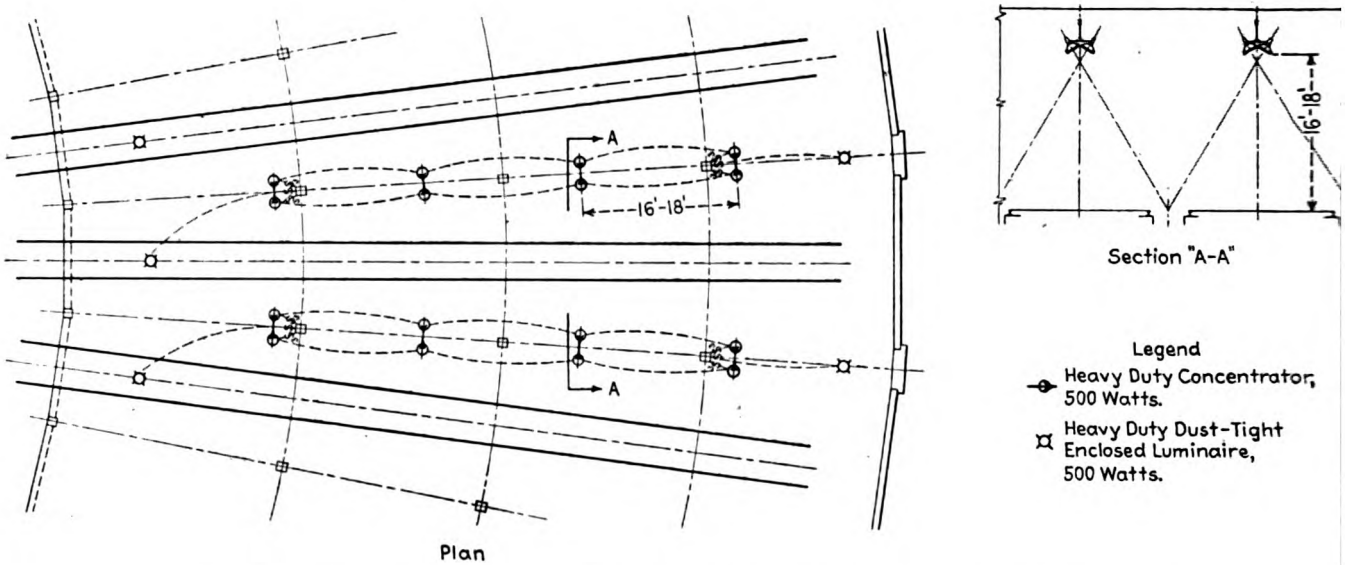


Fig. 2—Typical lighting layout for enginehouse stall—Units are tilted to center light beam on work area

Fig. 2 illustrates the recommended layout for a typical engine stall. Four 500-watt concentrators are required on each side of the average stall. They should be mounted about 18 ft. above the floor on 16- to 18-ft. centers and directed to give maximum vertical lighting. This arrangement with 500-watt lamps will give approximately 20-25 footcandles initially on the sides of the locomotives.

One 500-watt, dust-tight enclosed luminaire (Fig. 4) should be installed at each end of the stalls for general illumination.

Installation Experience

The wiring should be so arranged to permit any one stall to be illuminated without lighting the others. A convenient means of control can be provided by locating three-way switches at each end of the stall.

Several installations of this description have been in service for some time and results to date are excellent.

Fig. 3—Heavy-duty enginehouse concentrator designed to resist corrosion and minimize maintenance

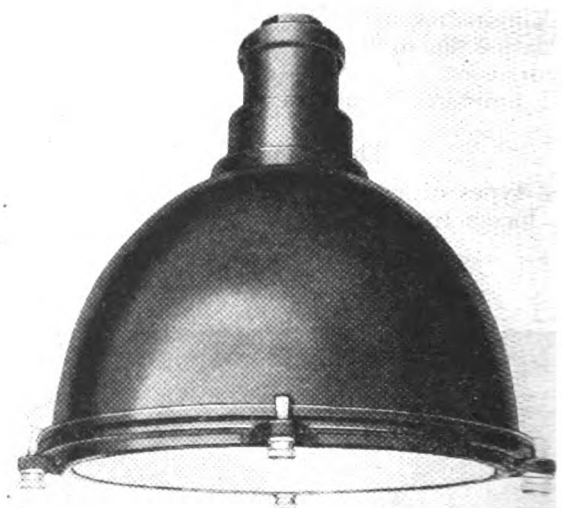


Fig. 4—Totally enclosed dust-tight luminaire for end-of-stall lightin and other general illumination applications

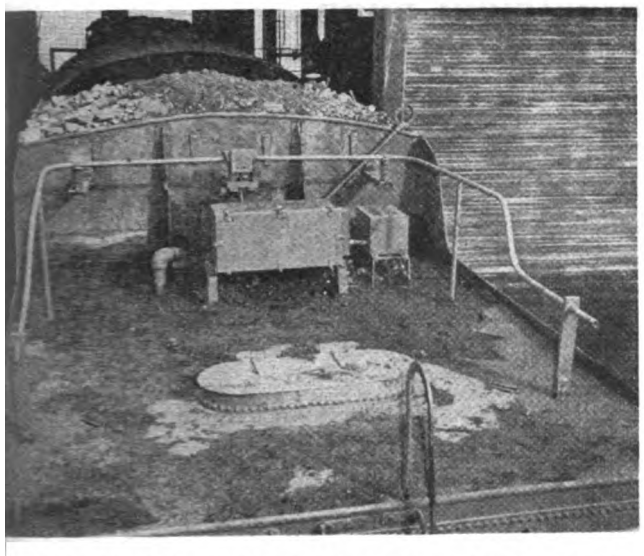
One such system completed in 1936 is worthy of detaile mention. Galvanized conduit was installed and ever three years was coated with a lead and oil paint. In few years severe conduit corrosion was observed, the the entire conduit system was coated with a no-oxid grease type paint. This treatment prevented furthe corrosion and appears to be the solution to the corrosio problem.

Good Maintenance is Vital

Experience has definitely proven that regular an careful maintenance is vital to the life of an enginehous lighting system. When corrosion is checked in th early stages, a well designed system will be relatively trouble-free for many years.

With the current severe overload on railway equipment, it is essential that locomotives be serviced carefully but quickly. Better enginehouse lighting for around-the-clock operation is one answer to this serious railroad problem.

New Haven Tests Train Radio



The dipole antenna is grounded at nodal points to afford protection from possible contact with live overhead wires—The end portions are bent down to make room for the water spout

Continuous contact maintained between locomotive and caboose with no appreciable fading either in cuts or on curves

A DEMONSTRATION of space radio train communication was made on the New York, New Haven & Hartford on April 17 with equipment manufactured by the Westinghouse Electric and Manufacturing Company. One set of equipment was installed as a fixed unit in the railroad station at New Haven, Conn., and two units respectively in locomotive No. 3205 and a caboose No. C-580. For the demonstration the mobile units were attached to opposite ends of a hundred-car freight train and run from New Haven to Danbury, Conn., over a rugged terrain involving many curves. Good loud speaker reception was maintained at all times between the locomotive and the caboose and for a distance of about 10 miles, between the fixed station and the train. To indicate the usefulness of the radio it was employed for announcing readiness of departure from either end of the train, for notifying the engineman when the train line pressure was up in the caboose, for indicating where the train was to be cut in switching operations, for advising the position of the ends of the train when it was placed on a siding, etc. No emergencies such as hot journals developed during the run.

One point of interest occurred at starting when the engineman notified the conductor the moment the locomotive started, and a watch in the caboose showed that the time to take slack and start the caboose was 48 seconds.

Radio Equipment

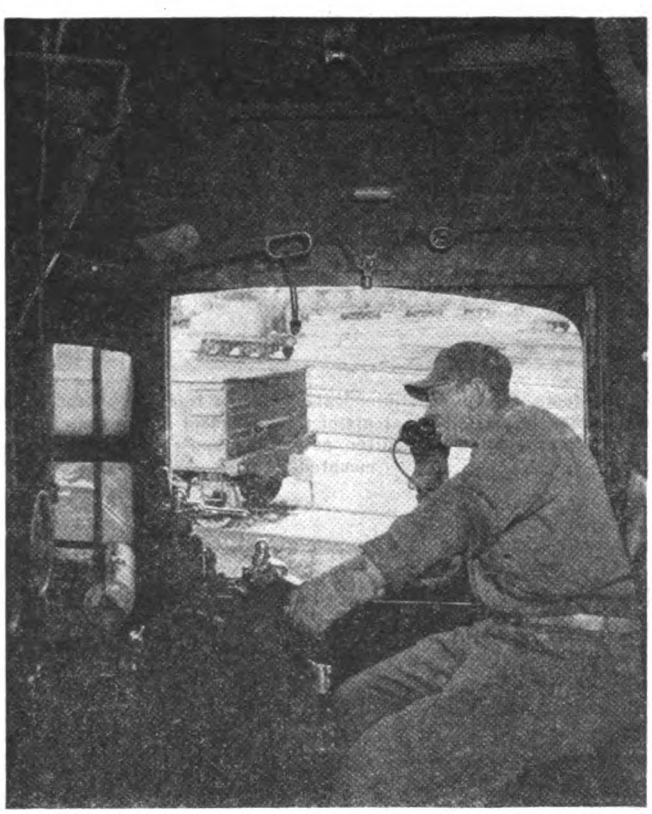
The radio sets used at the three locations are essentially similar except that the antenna output of the mobile sets is 30 watts while that of the fixed station is 60 watts. The experimental frequency employed is 30.66 megacycles.

Each set is shock-mounted in a dust tight box and consists of a transmitter, a power unit and a receiver. The transmitters employ a crystal frequency of 958.125 kilocycles multiplied 32 times to produce the carrier frequency of 30.66 mg. The frequency deviation of the carrier is plus or minus 15 kilocycles. The receivers are triple detection, super-heterodyne, crystal-controlled oscillators, operating at 4.315 mg.

Standby power required for one of the mobile sets is 135 watts, while full operation requires 220 watts input to the set. On the locomotive the necessary power was obtained from the headlight generator and converted from 32 volts d. c. to 110 volts, 60 cycle, a. c., by a rotary converter. For the purpose of the test, a baggage car having axle generator equipment was coupled in the train adjacent to the caboose and power taken from the electrical system on the baggage car for the operation of the caboose equipment. Communication is maintained through push-to-talk hand sets, a loud speaker being used at each location, primarily for calling. The quality of transmission, however, is such that the loud speakers make an entirely satisfactory means of communication.

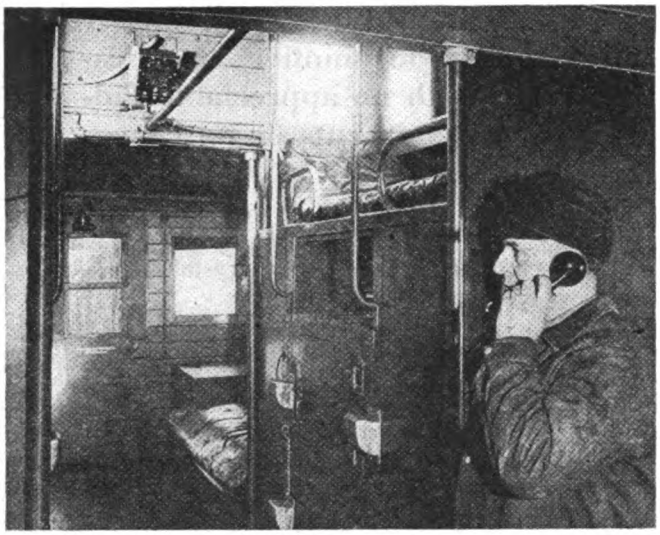
Antennae

The antennae used on the portable units were developed on the location and are of special interest since they had to be mounted within narrow clearance limits, and had also to be protected against possible contact with the 11,000-

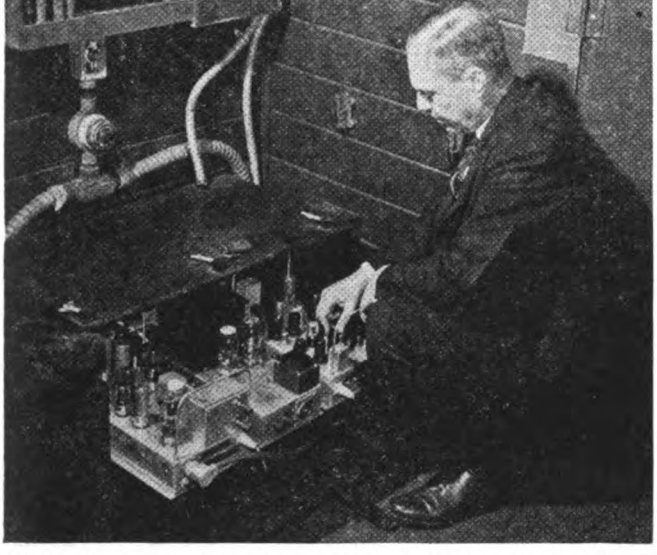


A push-to-talk hand set is used at both mobile and fixed stations

volt overhead trolley in electrified territory. The type selected for both locomotive and caboose and shown in one of the illustrations, is a dipole antenna consisting of two members, each one-half wave length long. Connection from the set to the antenna is made through coaxial cable



The loudspeaker shown in the cupola can be used for conversation, but is normally used only for calling



W. A. Moore, general superintendent of electric transmission and communications, inspects the contents of the equipment box in the caboose — This consists of a transmitter, power unit and receiver, all shock-mounted

with inductive coupling between the end of the coaxial cable and the two adjacent ends of the antenna halves. The center or nodal point of each half antenna is grounded. This grounding has no effect on the efficiency of antenna radiation but affords complete protection from contact with the overhead wire since there is no physical connection between the antenna and the set. The fixed antenna on the station at New Haven is mounted about 100 ft. above the ground and consists of two horizontal rings 56 in. in diameter grounded at one side and open at the other. Radiation from all three antennae is a maximum horizontally and is practically equal in all directions.

This is the third experiment the New Haven has ma with radio train communication, the first having be made in 1934 and the second in 1944.

Electrical Shop For Diesel Engines

(*Continued from page 220*)

quired are served by jib cranes. Winding of sh motors is done in the section of the shop shown in t lower right-hand corner of the shop plan drawing. T section at the lower-left will be devoted to winding traction motor and generator armatures. A plan vie of the shop is shown in Fig. 2.

Procedure

Equipment to be reconditioned is hauled from t erecting shop or storehouse on tractor-drawn trail (Fig. 3).

Normally the motors are delivered to the east or end of the shop where the motor-generator set is locat Here they are inspected and given a Megger insulati test and a running test with d.c. power at about 12 vo from the m.g. set. The amount of work to be done determined by the shop record card shown as Fig. 6 a by the condition of the motor as indicated by the insp tion. A preliminary inspection report is shown in Fig.

After the preliminary test and inspection, the motor moved by means of the crane to the west or right-

PRELIMINARY INSPECTION

Job No. .....

Serial No. ..... Name of equipment .....

Type or model No. ..... Manufacturer .....

Date received in shop ..... From .....

Armature serial No. ..... Pinion serial No. .....

Condition of commutator ..... Pinion ..... Shaft .....

Condition of brushholders ..... Brushes .....

Condition of external cables .....

Do both axle caps have same Serial No. as frame .....

Are grease pipes in good condition C. E. ..... P. E. .....

Is general condition of equipment clean or dirty .....

List below any major parts missing .....

.....

.....

Note 1 .....

Note 2 .....

Electrician ..... Machinist .....

Fig. 7—The requirements as indicated by the shop record card and preliminary inspection report shown above determine the amount work to be done on each motor

of the shop from which point the motor moves progr sively through the shop to final testing.

[Overhaul procedure will be described in Part II this article.—Editor.]

C. N. Telegraphs Employs Pole Setting Machines

Two pole-setting machines have recently been placed in service by the Canadian National Telegraphs. The users report that one of the machines can dig a six-foot hole in less than three minutes. In addition to digging the hole at almost any angle desired, the machine can pick up the pole and place it in position and can also uproot and remove old poles without requiring any softening up of the earth. The device is mounted on a Diesel Caterpillar tractor with over-size tread. The tube which houses the shank of the digging auger is fitted at the top with a pulley sheave and functions as a gin pole. A winch driven by the tractor engine does the lifting. With the aid of the machine, a three-man crew can set a mile of poles in one day. This amount of work previously required a gang of eight men for at least five days. Either a 16-in. or a 20-in. auger can be used. One of the units is now in operation in Mount Albert, Ont., 40 miles north of Toronto; the other, at Lundar, Man., 70 miles north of Winnipeg.

The machine digs holes and also sets and removes poles

C. P. R. Coach Is Fluorescent Lighted

Fluorescent lighting was installed in the Canadian Pacific coach No. 2169 while it was in the railroad's Angus shops at Montreal for general overhaul. The reconditioned car was placed on exhibit on March 1. It was one of the last to be built since the war started and the shopping period coincided with the receipt of a limited amount of lamps, plastics and a motor-generator set.

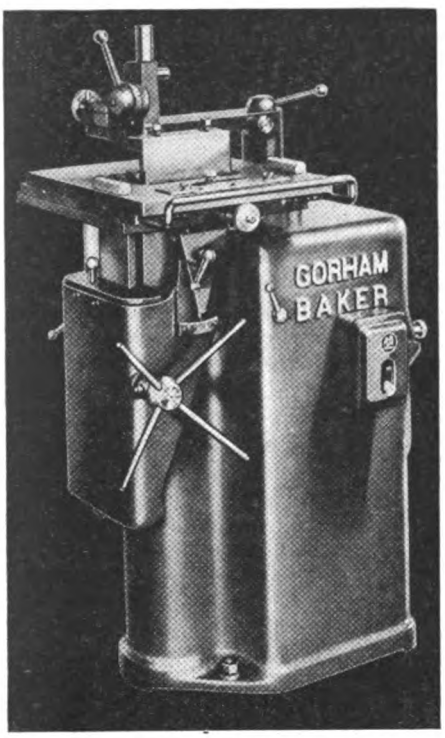
The car is lighted by thirty-six 14-watt, 15-in. T12 fluorescent lamps over the seats and fourteen 15-watt, 18-in., T8 lamps mounted on the surface of the ceiling for general lighting. The car has a seating capacity of 72 and there is a transversely mounted unit over each seat equipped with a plastic shade recessed into the underside of the parcel rack and an individual switch at the outer end of each fixture. The ceiling units are also transversely mounted. The lamps operate on 115 volts a.c. from a 1,200-watt motor-generator set supplied by the Safety Car Heating & Lighting Company of New Haven, Conn. The motor-generator set in turn receives its power from a 30-volt, gear-driven auxiliary.

The average lighting intensity on the 33-in. 45-deg. reading plane as taken at 20 locations is 5.7 foot-candles.

Reconditioned Canadian Pacific coach equipped with fluorescent lighting

Grinder for Finishing Contours

The grinding of contour tools such as flange and tread finishing tools for wheel work has always presented a difficult problem. The Gorham Tool Company, Detroit, Mich., has developed a contour grinder known as the Gorham-Baker grinder for



Gorham-Baker grinder for contour tools

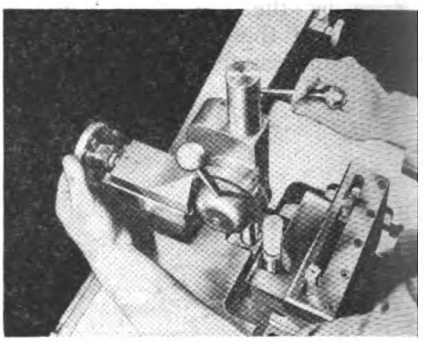
sharpening these tools in its own shop and is now making this machine available for railroad use. Although this grinder was developed primarily for grinding form tools for railroad tires and wheels, it can be used for a variety of form grinding operations.

The machine has a three-speed, V-belt-driven, vertical spindle mounted in anti-friction bearings. When using straight grinding wheels, a power vertical reciprocating motion can be imparted to the entire spindle assembly. A lever controls the mechanism which actuates the reciprocating motion so that it may be thrown out when using a taper wheel or when dressing the grinding wheels.

The table consists of three plates, the bottom one of which is bolted to the knee of the machine and can be tilted 10 deg. each side of horizontal for grinding side clearance. A pointer and protractor scale indicates the degree of angularity. The middle plate rides on balls running in grooves, permitting free motion in relation to the stationary bottom plate. The top plate likewise rides on balls in grooves that are at right angles to the grooves in the bottom and middle plate. This permits free sidewise motion between top and middle plates. This combination of motions makes it possible to move the plate in any direction required to follow a contour. All three plates may be locked together. In the locked position the top plate is located so that the work is clear of the wheel and a cut-out in the plate permits the wheel dressing diamond to pass entirely by the wheel length.

The template to which the form is to be ground is fastened to the top plate and clamped against the backing plate which takes the thrust on the template and holds the template square with the work holder. Slots permit sidewise adjustments of the template. In operation the template is brought against a roller which revolves on a stud carried on a block dovetailed into the bottom plate. The rollers against which the template rides are precision ground to step diameters and the grinding wheel, as later described, is dressed to correspond. The position of the dovetailed slide governs the relation of the work piece to the wheel. The feed of the work into the grinding wheel is controlled by the knurled hand wheel which moves the dovetailed slide in or out. Since both the template and the work are attached to the top plate, the form of the template is accurately ground on the work.

The work holding block slides in a channel in the top plate. The bottom of the



Setting the diamond to dress the grinding wheel

holder is ground in the plane of the to plate with the background square so tha the work is held parallel to the templat back plate.

When grinding with a taper wheel, th work is clamped flat on the bottom plat of the holder. A 10-deg. angle bloc which keys into the bottom plate is fur nished for staging work to grind a 1 deg. end clearance when using a straigh wheel.

A diamond wheel dresser is mounted o a dovetailed slide attached to a swive arm. The dressing head rotates 40 deg each side of vertical for dressing tape wheels. The travel of the dresser is con trolled by a hand lever. The angle o

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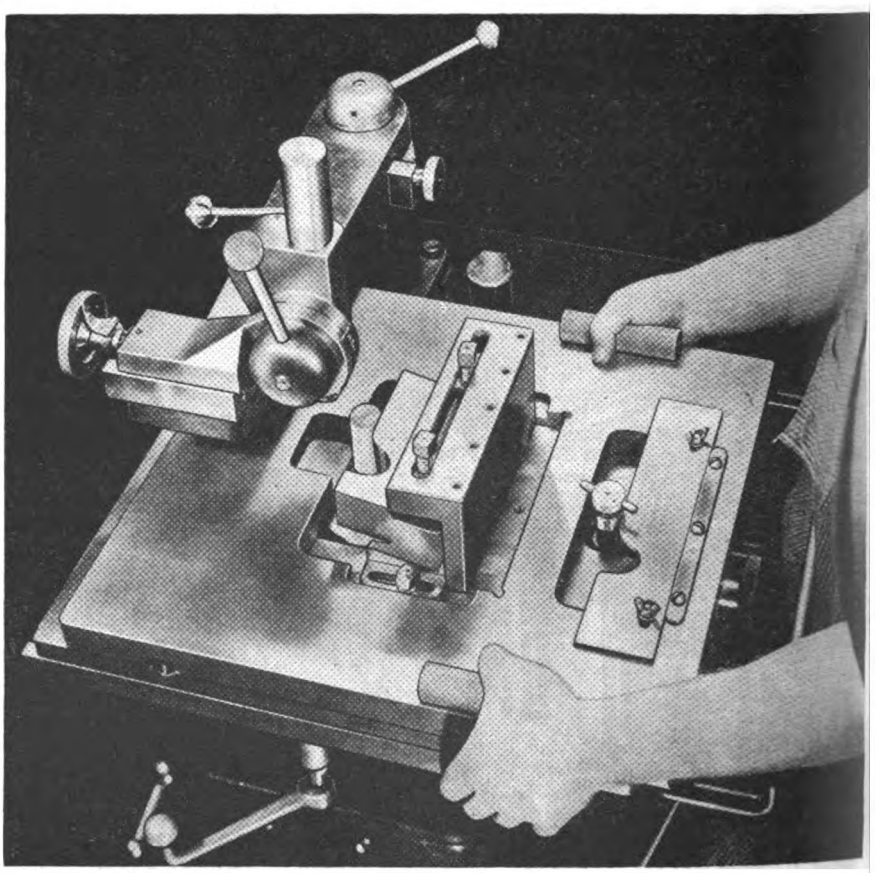
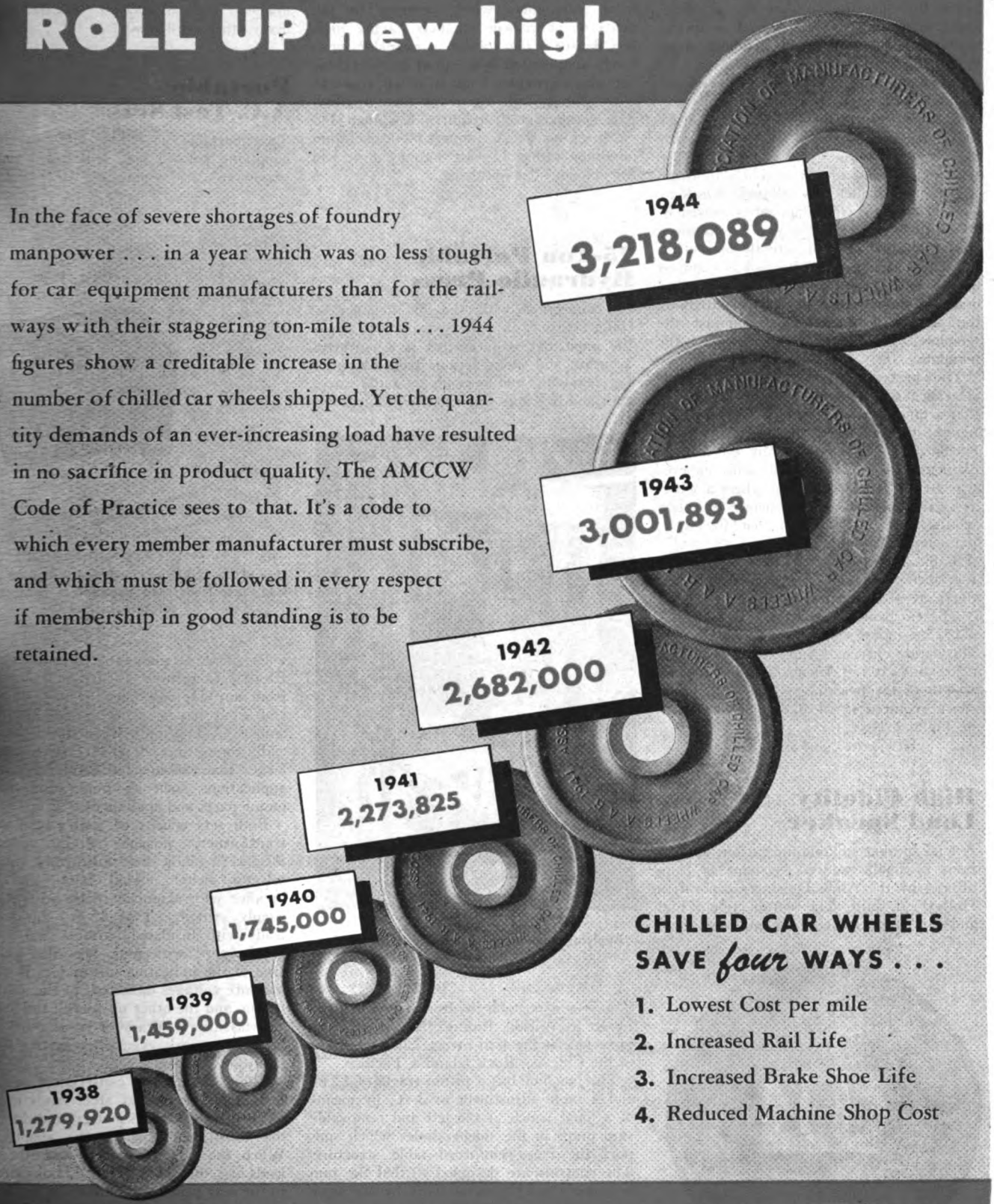


The template against the roller controls the grinding wheel

CHILLED CAR WHEELS ROLL UP new high

In the face of severe shortages of foundry manpower . . . in a year which was no less tough for car equipment manufacturers than for the railways with their staggering ton-mile totals . . . 1944 figures show a creditable increase in the number of chilled car wheels shipped. Yet the quantity demands of an ever-increasing load have resulted in no sacrifice in product quality. The AMCCW Code of Practice sees to that. It's a code to which every member manufacturer must subscribe, and which must be followed in every respect if membership in good standing is to be retained.



CHILLED CAR WHEELS SAVE *four* WAYS . . .

1. Lowest Cost per mile
2. Increased Rail Life
3. Increased Brake Shoe Life
4. Reduced Machine Shop Cost

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE, NEW YORK, N. Y. • 445 NORTH SACRAMENTO BOULEVARD, CHICAGO, ILL.

Organized to achieve: Uniform specifications — Uniform inspection — Uniform product

4015

the dressing head is read directly from a graduated scale. The feed of the diamond to the wheel is governed by a knurled graduated hand wheel controlling the movement of the dovetailed slide. The graduations on this knurled wheel are on the side facing the operator so that the grinding wheel diameter may be reduced in increments corresponding to the diameter steps on the follower rollers.

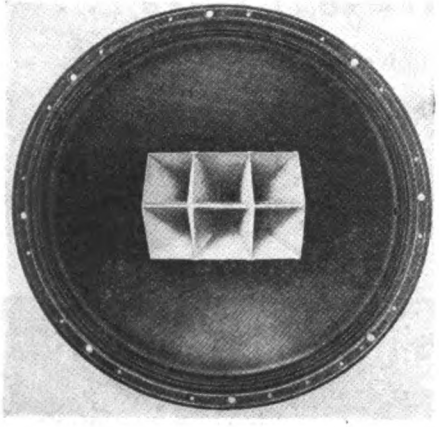
In grinding the Tru-Form tool the operator first selects the template that suits the tool. The straight grinding wheel is used and if dressing is needed this is done with the setting at zero. The diameter of the grinding wheel is measured and a follower of the same diameter is selected. On subsequent dressings the diamond is moved in by multiples of .005 in. so that the follower can be selected without actually measuring the wheel each time. The tool is clamped in the holder, adjusted and the grinding done by moving the table as permitted by the action of the follower against the template. The tool is ground to match the template.

The procedure for grinding constant-clearance tools is much the same except that a tapered wheel is used. When dressing the tapered wheel the dresser is swivelled to a 6-deg. angle. Only the .750 in. diameter follower is used with tapered wheels. After dressing the wheel a gauge is used to adjust the tool height by means of the knee elevation so that the wheel diameter at the cutting edge of the tool is .750 in. diameter thereby assuring a contour being ground on the tool an exact duplicate of the template.

The Gorham-Baker grinder is driven by a 1½-hp. motor operating on 220/440 volts alternating current. Spndle speeds of4,500, 6,500 and 10,150 r.p.m. are used. The weight of the machine is 1,100 lb. and the space required is 24 in. by 28 in. by 52 in. high.

High Fidelity Loud Speaker

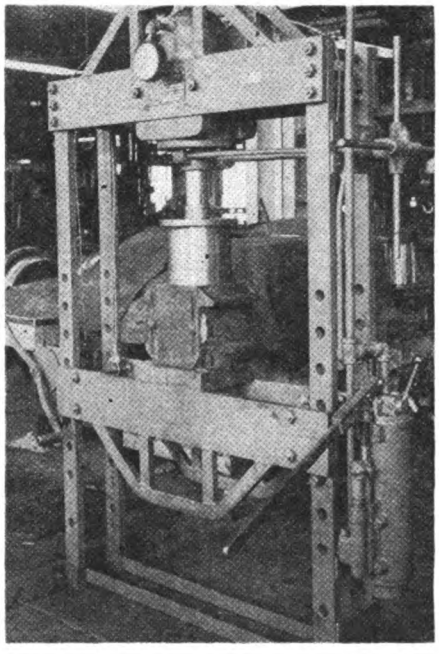
A loud speaker suitable for various applications of public address systems is being offered by the Altec Lansing Corporation, Hollywood, Calif. The reproduction of high and low frequencies is accomplished by a multi-cellular high-frequency unit placed within a conical low-frequency unit. The high-frequency unit employs an aluminum-alloy metal diaphragm, while the low-frequency assembly is mounted in a 15-in. stiff paper cone. Voice coils are wound with rectangular wire operating in the fields of permanent magnets having high flux density. The speaker is available separately or mounted in a walnut finished cabinet which provides 8 cu. ft. of air space to allow for a wide range of tonal quality. The speaker itself requires less than 1½ cu. ft. of space. A compact 60-decibel-gain amplifier with a 15-watt output can be had for driving the speaker.



The speaker is designed to radiate over a wide range of frequencies and is rated at 15 watts

75-Ton Portable Hydraulic Press

In connection with the maintenance of roller bearings on railway equipment, one of the important requirements is a powerful, accurate and quick-acting hydraulic press for removing and re-applying outer races, cups and bearings. The machine illustrated



Applying the outer race in a roller-bearing journal box

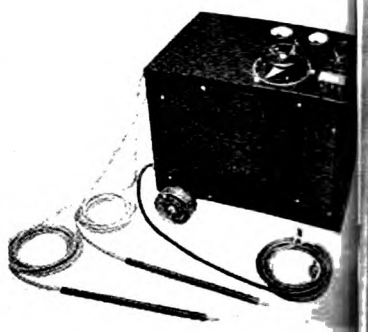
is a 75-ton portable hydraulic press, made by K. R. Wilson, Buffalo, N. Y., and now in service at the 47th Street, Chicago, shops of the Chicago, Rock Island & Pacific.

The machine has a piston travel of 12 in. and a table adjustment of 3 ft., by means of a hand winch at the left and removable stop plugs in the sidebar holes which support the truss-reinforced table structure. The controls are designed so that the ram is brought quickly to the work by operation of the hand lever at the right in conjunction with the large low-pressure cylinder. A simple shift of the control lever then applies pressure through a smaller cylinder which gives pressures up to 75 tons on the ram without exceeding the safe load on the machine. Gauge pressures above 75 tons on the gauge are shown on a red di as a warning to press operators.

In addition to the work in connecti with roller bearings, the press is used f applying bushings in brake levers heads, straightening shafts up to 4 in. diameter with an accuracy of .002 in., many other similar jobs.

Portable A.C. Test Sets

Two portable a.c. test sets, capable supplying smooth test voltages from 0 maximum rated voltages (2,000 and 6,



One of the 2,000-volt test sets, showing lead, test leads, and handwheel connecti autotransformer

volts), have been announced by the Ge Electric Company. Either set can op from any 115-volt, 50- or 60-cycle and each has a capacity of 2,000 amperes. The units were developed cially for testing Diesel-electric locom larger than 600-hp., but have other te applications such as generators, mo motor parts and appliances.

Both sets consist of a dry-type st transformer, variable-voltage autot former, two indicating voltmeters, voltm selector switch, signal lamp, air ci breaker with magnetic overload trip a supply switch. Two 15-ft. shielded leads with insulated handles and a supply cord with plug are also inclu One of the indicating voltmeters is use measure voltages up to half of the maxi rating, and the other up to full test vol This assures accuracy of results and e nates guesswork, even when testing at tively low voltages.

These compactly constructed sets housed in rectangular steel cases mou on three-wheel trucks and grounded thro the third conductor in the supply When the sets are not in use, the leads are coiled and hung on hooks attac to the rear panel of the case. A handle remains in a vertical position when in use is provided so that the set may easily moved.

Both sets are 19 in. high. The 2,000 unit is 18 in. wide, 22 in. long and we 290 lb., while the 6,000-volt set we 325 lb. and is 15 by 25 in.

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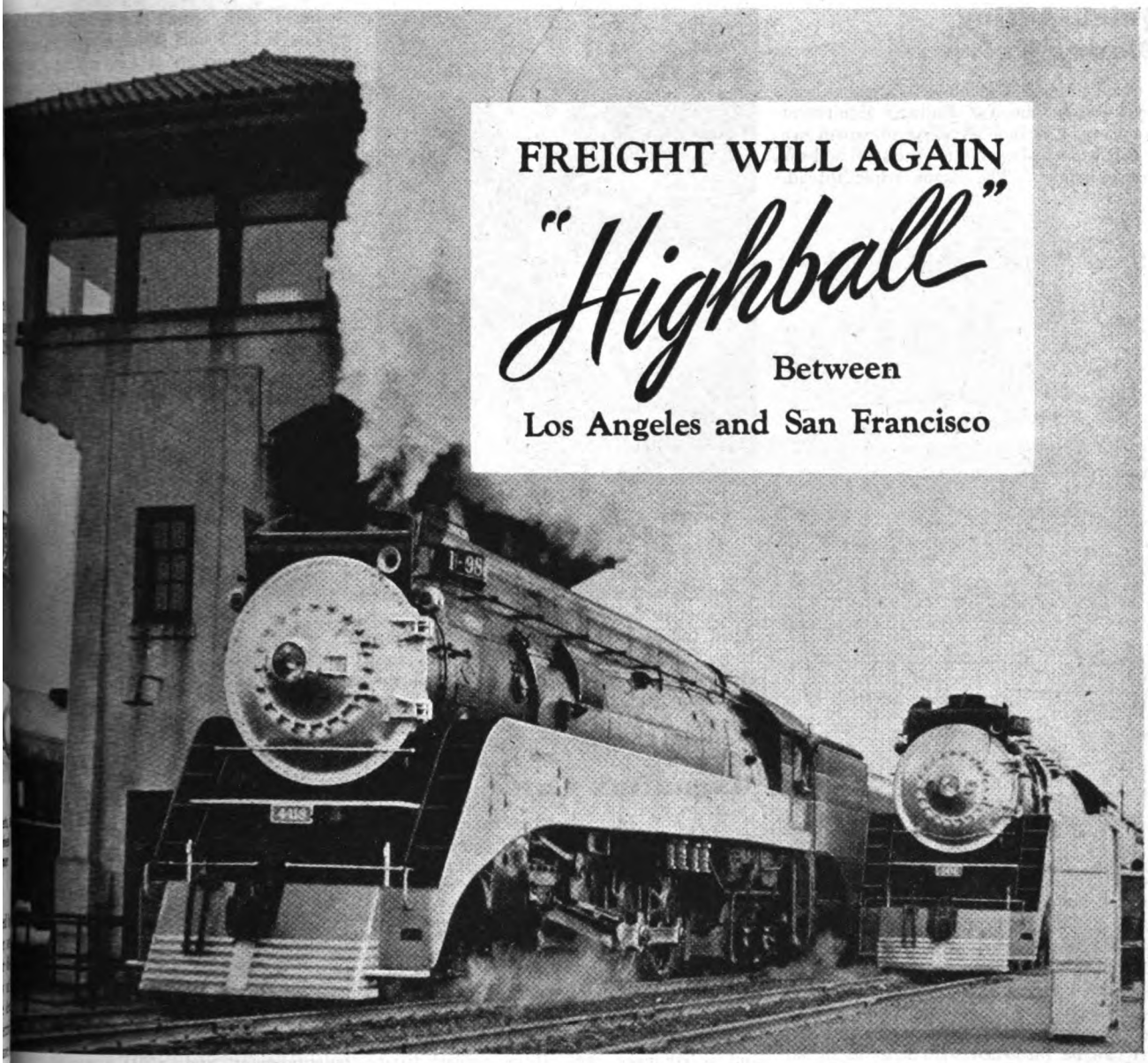


Before the war freight was highballed on the Southern Pacific between Los Angeles and San Francisco, making the 425 mile run overnight.

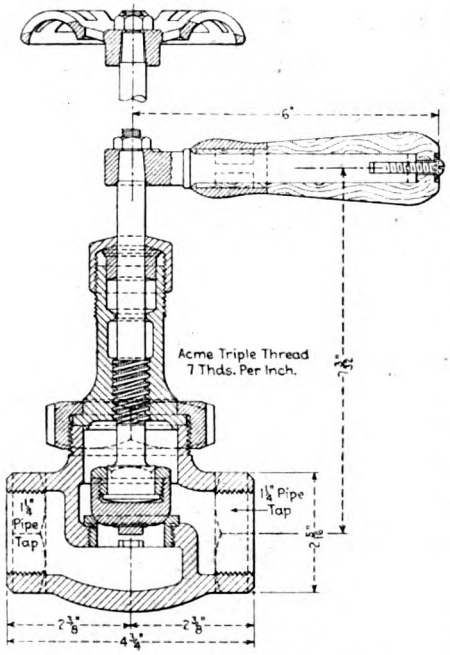
The trains were hauled by the same class of 4-8-4 super-power Lima locomotives that speed its famous passenger trains - - - the streamlined "Daylights."

The Southern Pacific plans to resume this cannonball freight service as soon as possible in the post-war period and is already equipped with the motive power, now having a fleet of sixty 4-8-4 Lima locomotives to be utilized on its "Overnights" as well as its "Daylights."

LIMA LOCOMOTIVE WORKS, LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

Quick-Acting Blower Valve

A quick acting 1¼-in. blower valve has been developed by the T-Z Railway Equipment Company, Chicago, all parts of which are A.A.R. standard except for the stem and the bronze bonnet. The Acme triple thread,



The T-Z quick-acting blower valve

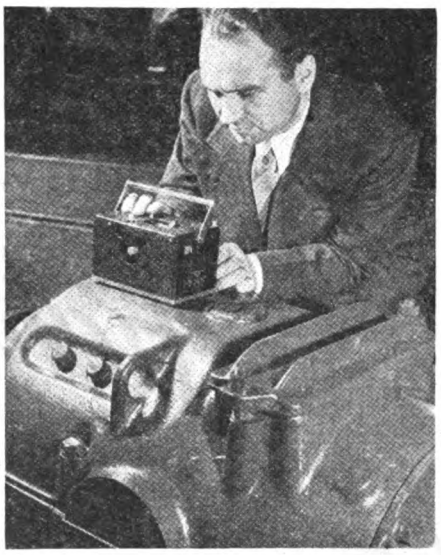
seven threads per inch, on the brass stem permits the valve to be fully opened or closed quickly by turning either the A.A.R. standard hand wheel or the lever. The stem is fitted with a removable ball-type disc seat made of nickel-alloy. This disc, in turn, seats into a removable ring made of the same material.

It can be furnished with a globe or an angle valve body, both of which are made of steel. All other parts are made either of brass or bronze.

Vibration Recorder

An instrument called the Vibrograph has been produced by the Westinghouse Electric & Manufacturing Company to meet the requirement for a quick simple means of recording vibration on the spot. The instrument, which looks something like a box camera, weighs less than nine pounds and requires no power connection. It writes a permanent record of vibrations over the range of 600 to 15,000 cycles per minute with amplitudes as low as one ten thousandth of an inch or as great as one sixteenth of an inch. The record and a timing wave, which are drawn by a stylus on a transparent plastic tape one inch wide, are viewed by a low-power microscope.

The Vibrograph is a mechanical device and achieves mechanical amplifications of about eight, using the same principle by which earthquakes are recorded. It consists essentially of a frame containing a mass suspended by a weak spring. A



The instrument is a mechanical device which amplifies and records vibration

pointer attached to the mass indicates relative motion between the frame and mass when the frame is applied to a vibrating body. The record is made on the tape, either when the instrument is placed on the vibrating body or when held in the hand, and the vibration is picked up by a prod.

Magnaflux Unit

A Magnaflux unit designed especially for the railroad field has recently been introduced by Magnaflux Corporation, 5900 Northwest Highway, Chicago 31. This unit is suitable for the detection of fatigue cracks and other discontinuities in practically all locomotive, car and similar steel parts. It is recommended for use in enginehouses, car shops, etc.

Designated as Type KT-2.5, this unit is of push-cart style, has folding handlebars and is equipped with 16-in. rubber tired wheels and heavy eyebolts to facilitate handling. It is ruggedly and compactly constructed with an all welded steel frame.

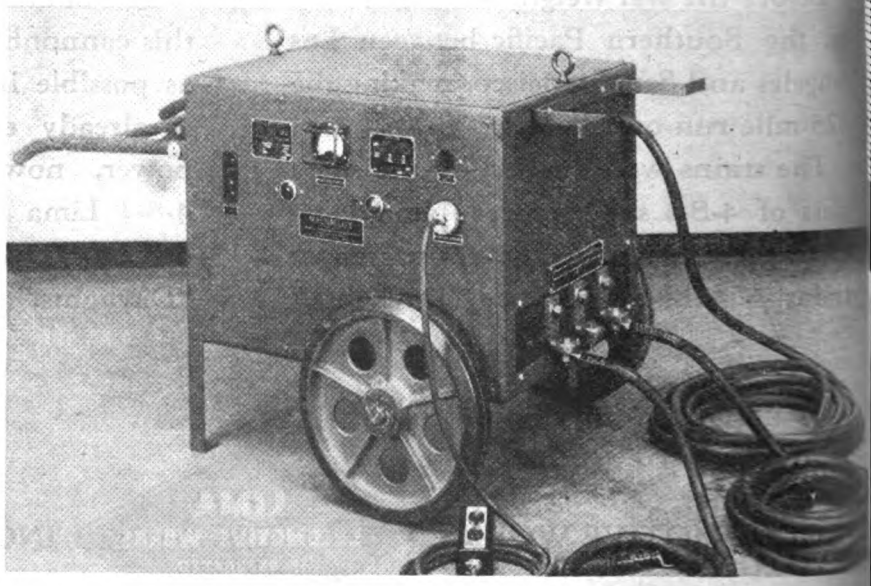
The KT-2.5 unit delivers high values of alternating current at low voltage which may be used for both magnetization and demagnetization. It is usually constructed for interchangeable operation on 220- or 440-volt, 60-cycle, a.c. circuits, and may be obtained for operation on other standard voltages and frequencies.

Ground Resistance Tester

An instrument for testing ground resistance, designated as Model 255 Vibroground, having ranges of 0/3, 0/30, 0/300 and 0/3,000 ohms, is being offered by Associated Research Incorporated, Chicago.

The set is suitable for measuring ground resistance under conditions of extreme dryness or moisture

A test voltage of 175 is developed by a synchronous self-rectifying vibrator, receiving its power from two dry-cells. Voltage measurements are made by means of a potentiometer and a D'Arsonval galvanometer reading directly in resistance when a condition of voltage balance is obtained.



Magnaflux unit designed especially for railroad use

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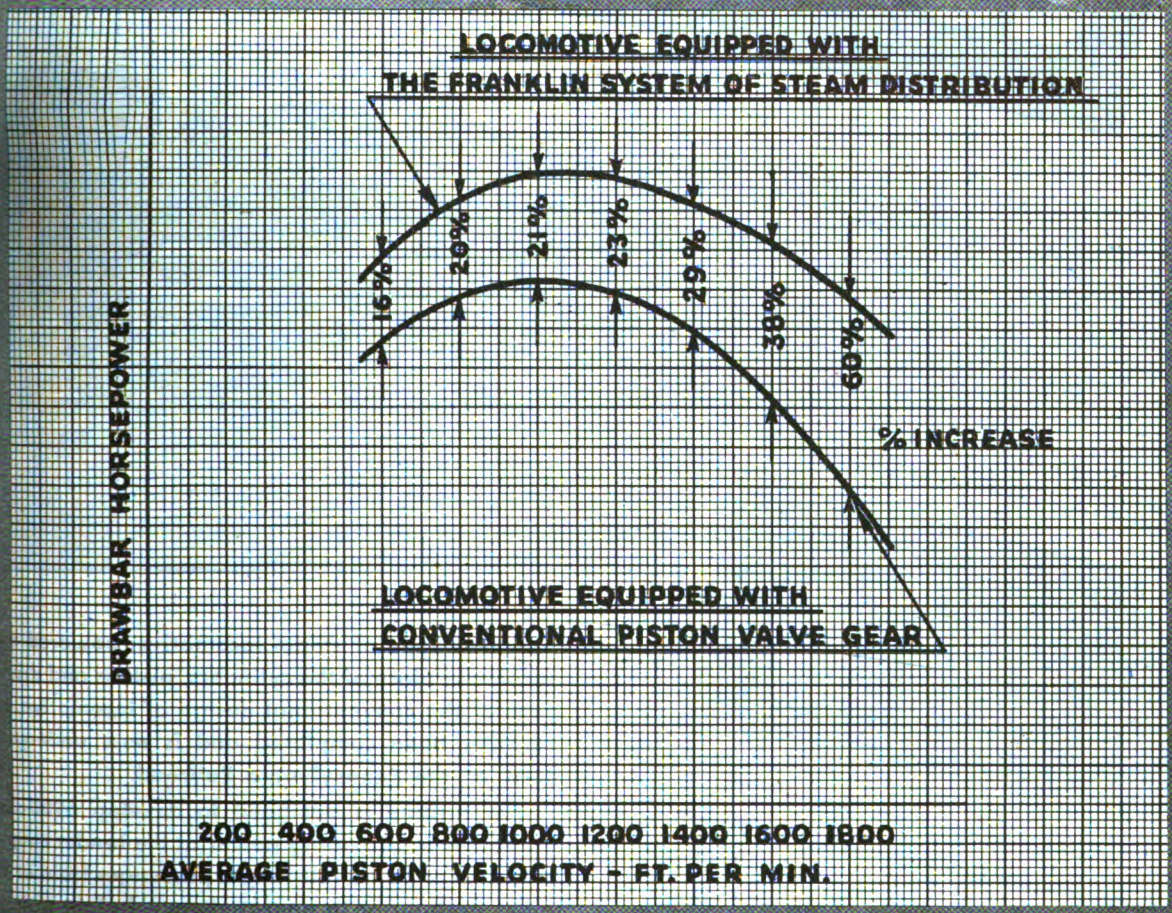
Increase in Drawbar Horsepower

obtained with
typical application of

THE FRANKLIN SYSTEM of STEAM DISTRIBUTION



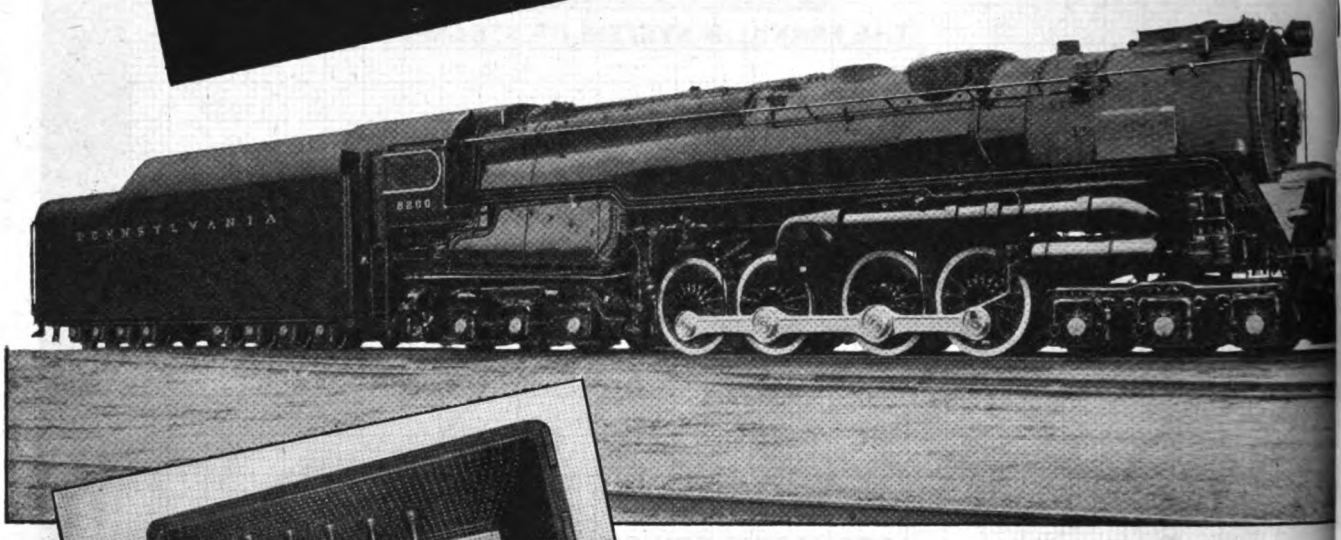
Both curves are established on the basis of the same amount of steam to the cylinders. The Franklin System assures a substantial increase in horsepower output and economy, for either passenger or high speed freight service.

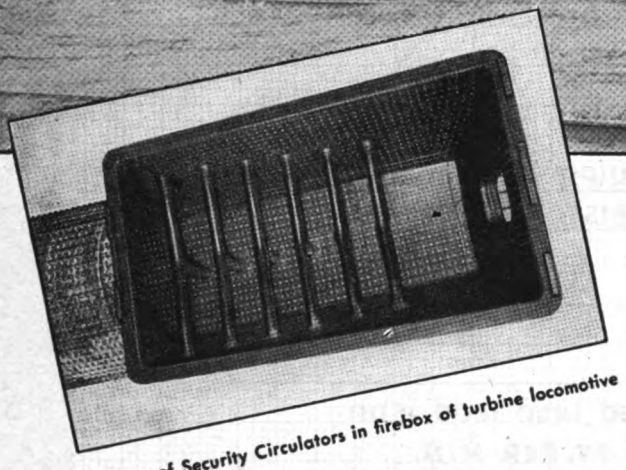
FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO

In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

better combustion





Position of Security Circulators in firebox of turbine locomotive

A new type of steam locomotive, powered by a turbine in place of the cylinders, pistons and driving rods of the conventional design of locomotive, has recently been completed and is now undergoing tests on the Pennsylvania Railroad.

The turbine is designed to develop 6900-shaft horsepower, providing power at the tender coupled sufficient to pull a full-length passenger train at 100 miles an hour or to operate heavy freight trains at high speeds.

American Arch

SECURITY CIRCULATOR DIVISION

for the New

STEAM TURBINE LOCOMOTIVE

BY THE APPLICATION OF

SECURITY CIRCULATORS

• This new type of steam locomotive, undergoing tests for the Pennsylvania Railroad, is creating interest in all railroad engineering departments. It is modern, advanced and a product of years' experience in locomotive development by the railroad and the builders.

The Security Circulators used to support the arch and as a circulating device in the firebox of this locomotive were the culmination of proven ability in other classes of power.

The following advantages are secured through the application of Security Circulators.

Security Circulator equipped locomotives are available for continuous operation for longer periods than other locomotives because they have cleaner flues, longer arch life, and improved combustion so that boiler maintenance is greatly reduced.

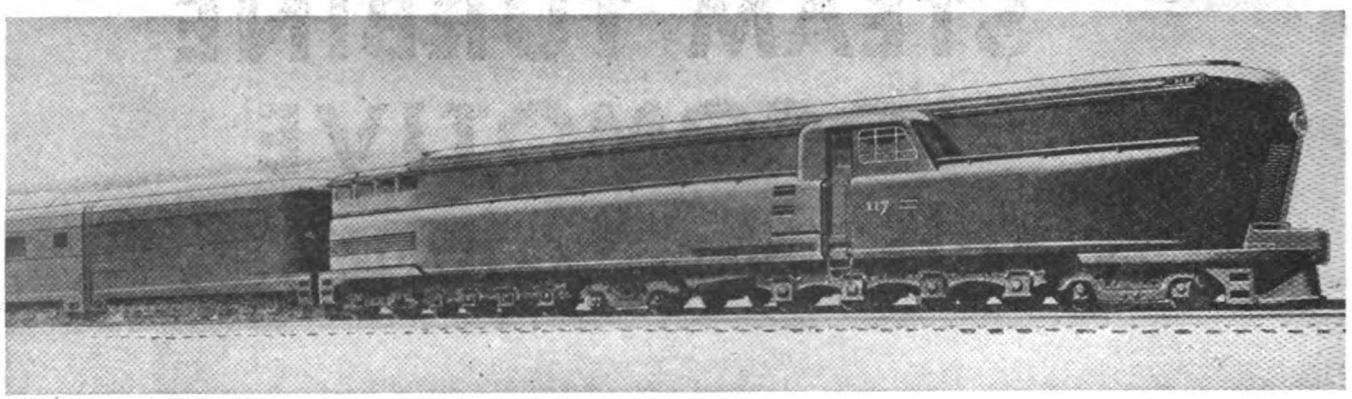
With Security Circulators circulation is improved over crown sheets and in side water-legs; and honeycombing, flue plugging and cinder cutting are reduced.

The installation of Security Circulators permits the use of a 100% arch in any type of fire box and increases the life of the arch brick.

Company, Inc.

NEW YORK · CHICAGO

NEWS



A proposed Chesapeake & Ohio steam-turbine-electric locomotive

Propose Steam-Turbine Locomotives for the C & O.

THE Chesapeake & Ohio, on March 28, asked W. P. B. permission to build three coal-burning turbine-electric locomotives. The new locomotives will develop 6,000 hp. delivered from a steam turbine to generators and will be capable of running more than 100 miles an hour.

The Baldwin Locomotive Works already has completed the basic designs. C. & O. engineering personnel is collaborating with Baldwin in completion of design details. The steam turbine and electrical equipment are designed and will be built by the Westinghouse Electric & Manufacturing Company. The cab will be near the front end of the locomotive. The coal supply will be carried at the head end instead of in the tender, as at present. The boiler will take up the center section behind the engineman's cab. The steam turbine and electric generators, with a capacity of 4,000 kw., will be placed at the rear. Motors will be mounted on each of the driving axles.

The locomotives, according to a statement issued by Carl E. Newton, president of the C. & O., are being built for the specific purpose of powering separate sections of a projected new streamline train which will be constructed as soon as critical materials and manpower become available.

Army Releases Steel for 2,000 More Box Cars

A DIRECT transfer of carbon steel from the Army to the Office of Defense Transportation will enable the production of 2,000 additional new box cars in the first nine months of 1945, the O. D. T. has announced.

The Army has turned over 34,000 tons of carbon steel for the second quarter of 1945, the O. D. T. said, bringing the total box-car production for the first nine months of 1945 to the "desired goal" of 20,000.

Col. J. Monroe Johnson, O. D. T. director, said that the railroads have placed orders for all these new cars. He expects the cars to be in service by October, in time for the heavy grain movement due at that time. In addition, they will also place the railroads in a better position to handle the increased freight traffic to the west coast called for by huge shipments of war materials to the Pacific theater.

The action of the Army, Colonel Johnson said, indicates a recognition on its part of the importance of the box-car program as an essential feature of the war effort.

N. Y. C. 4-8-4 Locomotive — A Correction

THE 25 4-8-4 type locomotives which are on order with the American Locomotive Company for the New York Central will have 79-in. wheels. Through a typographical error this dimension was given as 29 in. in the caption under the illustration on page 188 of the April *Railway Mechanical Engineer*. The locomotives are Class S-1.

Miscellaneous Publications

NORFOLK & WESTERN LOCOMOTIVES.—The Norfolk & Western has issued a plastic-bound booklet, with cover in colors, descriptive of its modern coal-burning steam locomotives, "modern" being used to designate those locomotives with high-capacity boilers with roller bearings on all engine and tender wheels, one-piece cast-steel bed frames, improved counterbalancing, and complete mechanical and pressure lubrication. The locomotives described in the booklet are of three types: (1) a streamline passenger locomotive, Class J, with a 4-8-4 wheel arrangement; (2) a single-expansion articulated freight and heavy passenger locomotive, Class A, with a 2-6-6-4 wheel arrangement, and (3) a heavy Mallet compound freight locomotive, Class Y6, with a 2-8-8-2 wheel arrangement. Each of these types is illustrated and data are given on the performance, maintenance cost, fuel economy, and utilization.

Burlington Plans Glass-Domed Passenger Car

WORKING in conjunction with engineers and draftsmen of the General Motors Corporation, the Chicago, Burlington & Quincy, through its president, Ralph Budd, has announced plans for the construction of a new type of passenger car which will be featured by a dome made entirely of glass.

According to Mr. Budd sculptors, designers and artists of General Motors had conceived the idea of giving railroad passengers an entirely new and unobstructed view of the country through which they ride by designing a car "without any inhibitions or restrictions such as past railroad practices or standards." As a result a car has been produced which is provided with an upper level of seats and with glass domes of an unusual design.

According to present specifications, the floor of the middle section of the car will be slightly lower than in standard cars and will be roofed with a glass-enclosed dome. In addition to providing the two seat levels the car will add to the seating capacity. For experimental and demonstration purposes a standard car will be remodelled to conform with the new design.

Train Telephone for the C. of N. J.

THE Central of New Jersey is turning to train telephone to help improve coordination of switching movements in its busy Allentown, Pa., yard. A one-way inductive installation will be made in the yard office at the westbound hump and on locomotives working in that section of the yard. Radio also is being studied for possible

(Continued on second left-hand page)

Essential in Locomotive Boiler Design

. . . Ample *Free* Steam Area between Boiler and Cylinders

Maximum free steam area is obtainable only with the Elesco superheater as applied to boilers with maximum evaporating surface.

Consult our Engineers when you are considering new power.

ELESCO

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SUPERHEATERS • FEEDWATER HEATERS
AMERICAN THROTTLES • STEAM DRYERS
EXHAUST STEAM INJECTORS • PYROMETERS

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IT'S A GREAT NEW DAY FOR RAILROADING

100% AVAILABILITY on the PANAMA LIMITED and CITY OF MIAMI

GENERAL MOTORS
LOCOMOTIVES

IT'S A GREAT NEW DAY FOR RAILROADING

During May, June
and July last year,
three General Motors
Diesel locomotives
operated at 100% availability
over 237,144 miles on these
two crack trains of the
Illinois Central.

Remarkable?
Yes, but not unusual
for GM Diesels.

ON TO FINAL VICTORY ★ BUY MORE WAR BONDS

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION LA GRANGE, ILL.

Orders and Inquiries for New Equipment Placed Since the Closing of the April Issue

LOCOMOTIVE ORDERS

Road	No. of locos	Type of loco.	Builder
Pere Marquette	10	1,000-hp. Diesel-electric	Electro-Motive

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Alton	500[1]	Box	Pullman-Standard
Clinchfield	1,000	50-ton hopper	American Car & Fdy.

FREIGHT-CAR INQUIRIES

Road	No. of cars	Type of car	Builder
Bangor & Aroostook	50-100	70-ton hopper	
	50-100	50-ton rack	
Canadian National	500	50-ton box	

[1] Authorized by Federal Judge John B. Barnes. Cost, $1,675,000.

application at other points on the railroad.

The Jersey Central's first radio installation is one of a number of improvement projects on the railroad's 1945 capital expenditures budget. The projects include several new structures for employees, a new tower and a new interlocking installation at V.N. tower, just east of the Allentown yard, other signaling improvements at various points on the railroad, new machine tools and mechanized equipment for shop, storehouse and maintenance-of-way work, additional floodlight and loudspeaker systems for the railroad's principal yards, and mechanical improvements at a number of specific locations.

Eksergian Receives Levy Medal

AT Medal Day exercises at the Franklin Institute on Wednesday evening, April 18, Dr. Rupen Eksergian, chief consulting engineer of the Edward G. Budd Manufacturing Company, received the Louis Edward Levy gold medal which was founded in 1923 to be awarded to the authors of papers of especial merit published in the Journal of the Franklin Institute. Dr. Eksergian's paper was entitled "On the Reaction of Fluids and Fluid Jets" and appeared in the May, 1944, issue of the Journal. It includes a discussion of rocket propulsion and jet drive for airplanes, together with some phases of the reaction of jets.

A. S. M. E. Semi-Annual Meeting

THE semi-annual meeting of the American Society of Mechanical Engineers will be held at 11 a.m. on June 18 at the Stevens Hotel, Chicago. The meeting will be devoted solely to the report of the tellers on the ballot for changes in the Constitution which has now been distributed to the members of the Society.

Responsibilities of Foremen — A Correction

E. R. BATTLEY, whose paper entitled "A Wide Range of Interests" appeared on page 147 of the April issue of the *Railway Mechanical Engineer*, is chief of motive power and car equipment of the Canadian National, not of the Canadian Pacific.

Supply Trade Notes

OHIO INJECTOR COMPANY.—*Joe W. Greene* has been appointed general sales manager of the Ohio Injector Company, Wadsworth, Ohio.

◆

NATIONAL MALLEABLE & STEEL CASTINGS COMPANY.—At his own request, *Henry F. Pope*, chairman of the board of the National Malleable & Steel Castings Company since 1934, was not re-elected to that post at the

Henry F. Pope

annual meeting on March 28 and the office of chairman was left vacant. Mr. Pope, who will continue as a director, has been active in the company since he began as an office boy with its predecessor, the Cleveland Malleable Iron Company, in 1884, and has served in various capacities including those of assistant treasurer, vice-president and president. He has been a director since 1899. *W. H. Moriarty*, assistant to the

W. H. Moriarty

president responsible for the direction of general policies and coordination between the five plants of the company for all industrial sales, has been assigned the additional duties of assisting in the administration of the railway sales department.

Army-Navy E Awards

American Foundry & Equipment Company, Mishawaka, Ind. Third star.

Copperweld Steel Company, Glassport, Pa. Fourth award.

DeVilbiss Company, Toledo, Ohio. Fourth award.

Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. Fifth renewal.

Pacific Car & Foundry Company, Billings, Mont.

United States Rubber Company, Passaic, N. J.

PITTSBURGH STEEL FOUNDRY CORPORATION.—*D. P. Morgan* has been appointed assistant sales manager, Philadelphia, Pa., district of the Pittsburgh Steel Foundry Corporation, Glassport, Pa. Mr. Morgan formerly was sales engineer of the Hanna Stoker Company, Cincinnati, Ohio, covering the railroad fields in the eastern and southern territories.

◆

OXWELD RAILROAD SERVICE COMPANY.—*Kenneth I. Thompson* has been appointed eastern sales manager of the Oxweld Railroad Service Company, with headquarters

Kenneth I. Thompson

at New York. Previously Mr. Thompson was western sales manager of the railroad department of the Ingersoll-Rand Company. He was born at Bridgeport, Conn., on March 28, 1904, and is a graduate of the Staunton Military Academy, Staunton, Va. In 1921 he entered the railway supply field as a salesman in the employ of the Penn-

sylvania Pump & Compressor Company. A short time later Mr. Thompson went with the Fuller Lehigh Company and in 1937 he became associated with Ingersoll-Rand.

◆

PRECO INCORPORATED. — Preco Incorporated, has recently opened district offices at 135 South LaSalle Street, Chicago, and 70 East Forty-fifth street, New York. The branch office will be in charge of *Paul H. Montgomery* and *Horace M. Wigney,* respectively.

◆

H. K. PORTER COMPANY.—*S. B. Heppenstall, Jr.,* has been elected vice-president of the H. K. Porter Company, Pittsburgh,

S. B. Heppenstall, Jr.

Pa., with headquarters in the general offices in Pittsburgh. Mr. Heppenstall formerly was vice-president in charge of sales of the Heppenstall Company.

◆

WARNER & SWASEY COMPANY.—*A. H. Keetch* has been appointed head of the newly organized sales-service department of the Warner & Swasey Company, Cleveland, Ohio, after a two years' leave of absence on government service. In Washington, Mr. Keetch served as chief of the priorities and distribution branch, tools division, War Production Board.

◆

ENTERPRISE RAILWAY EQUIPMENT COMPANY.—*O. A. Wallace,* who recently resigned as superintendent of the car department of the Atlantic Coast Line, with headquarters at Wilmington, N. C., has been appointed sales engineer of the Enterprise Railway Equipment Company, Chicago.

◆

BOSS BOLT & NUT COMPANY.—*Milton Strauss* has been elected president and treasurer of the Boss Bolt & Nut Co., Chicago, a division of the Lock Nut Corporation of America. Mr. Strauss recently purchased the controlling interest in the company. *C. J. Johnson,* secretary since 1927, has been re-elected to that position and appointed assistant treasurer. *George S. Hubbard* has been elected vice-president, continuing also as sales manager. *Edward J. Guck* of Detroit, Mich., for a number of years a production specialist and operator of his own plants, has been appointed general manager in charge of production.

BUFFALO FORGE COMPANY.—*Charles C. Cheyney* has been appointed sales manager of the Buffalo Forge Company, Buffalo, N. Y. Mr. Cheyney was for a number of years Chicago representative of the company. In recent years he has been assistant sales manager.

◆

AMERICAN ROLLING MILL COMPANY.—*Harry Holiday* has resigned as manager of the Butler, Pa., division of the American Rolling Mill Company because of illness. *Gordon Gage,* general superintendent, succeeds Mr. Holiday, and *Roy P. Tooke,* assistant chief of the company's general engineering department in Middletown, Ohio, has been transferred to Butler as general superintendent.

◆

GALVIN MANUFACTURING CORPORATION.—*Edward L. Pincus,* formerly chief field expediter for the Philco Corporation, has been appointed district sales manager, middle Atlantic states, for the Galvin Manufacturing Corporation, with headquarters in Philadelphia, Pa.

◆

DEARBORN CHEMICAL COMPANY.—*George R. Carr,* whose election as chairman of the board of the Dearborn Chemical Company, Chicago, was reported in the April issue, was born at Argenta, Ill., on January 23, 1877, and is a graduate of the University of Illinois (1901). Two weeks after graduation he joined the staff of Dearborn as a salesman and served successively until 1922 as assistant general manager and general manager. In 1922 he was elected vice-president and general manager, and in February, 1944, chairman of the executive committee.

George R. Carr

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*Henry G. MacDonald* has been appointed assistant vice-president of the Pullman-Standard Car Manufacturing Company, with headquarters in New York as heretofore. Mr. MacDonald is a graduate of Cornell University. He was with the Standard Steel Car Company from 1902 to 1930, rising from sales engineer to assistant to the vice-president. He was appointed assistant secretary of Pullman-Standard when that company was formed through the merger of the Standard Steel Car Company and the Pullman Car & Manufacturing Co., in 1930.

EATON MANUFACTURING COMPANY.—*E. D. Cowlin* has been appointed resident manager of the Reliance Division of the Eaton Manufacturing Company, Massillon, Ohio, assuming local supervision of manufacturing and sales operations as well as of all activities in connection with operations of the Reliance Division in Massillon. Mr. Cowlin was originally manager of the New York office. He is a past president of the National Railway Appliance Association, and holds memberships in the American Society of Mechanical Engineers, the American Railway Engineering Association, and the Canadian Railway Club.

E. D. Cowlin

◆

COOPER-BESSEMER CORPORATION.—*C. M. Bovard* has been appointed design engineer of the Cooper-Bessemer Corporation, Mount Vernon, Ohio. Mr. Bovard was previously chief draftsman.

◆

IRON & STEEL PRODUCTS, INC.—*David Newhall,* has been elected vice-president in charge of the New York district of Iron & Steel Products, Inc., Chicago, with headquarters at 780 Riverside Drive, New York. Mr. Newhall served the company in the same capacity several years ago.

◆

AMERICAN CAR AND FOUNDRY COMPANY.—*Frederick H. Norton* has been appointed assistant vice-president in the sales department with headquarters in New York. Mr. Norton attended the Morgan Park Military Academy, Chicago, from 1920 to 1924, and during this period worked part time for the Union Metal Products Company, now the Standard Railway Equipment Company. He later was employed by the Union Metal Products Company, first as office boy and then as draftsman, meanwhile attending night school and graduating in 1928. He is a graduate of Purdue University (1932) with a degree in mechanical engineering. He subsequently was employed as sales engineer by the A. L. Jackson Company and in 1934 became sales engineer in the Chicago office of the American Steel Foundries assigned to mid-western railroads. In May, 1940, he was appointed war production engineer and assigned to Washington, D. C., to handle all of the American Steel Foundries activities with the government and foreign agencies.

(Turn to second left-hand page)

The nearer we get the

Each stepping stone to Tokyo has been harder to take.

They said it couldn't come any worse than Guadalcanal. That even the nights were something you'd rather forget. Japs shrieking in the dark and rapping on trees and tossing rocks into foxholes—and now and then a grenade just to keep the boys guessing.

Then came Tarawa.

You heard how the landing boats got hung on a reef. How the boys had to wade in under cross-fire from the enemy. They said Tarawa would go down as the worst.

Then came Iwo Jima.

They said, a mile offshore, in the barges, the sea boiled like vegetable soup from Jap shelling. It was full of chopped-up boats. They said the Japs' big guns were above and they just aimed down hill and let go. They said it cost us five times the price of Tarawa. They said Iwo was the worst.

Next?

Let's make 7 unlucky

harder they fall !

Well—there's Chichi Jima, Haha Jima—fifteen islands to go. And then, of course, the ultimate objective—Japan itself.

You can help lower the price we'll have to pay—by buying War Bonds. Bonds to give our boys equipment to throw at the enemy. For the more *equipment* they can throw at them, the fewer *lives* they will have to give.

How much are *you* investing to help preserve American lives?

for the Japs!

7th War Loan

Contributed by

Steam Division
of American Locomotive
Company

ELLIOTT COMPANY.—*W. A. Elliott,* vice-president in charge of sales of the Elliott Company, Jeannette, Pa., has been elected executive vice-president. *Ronald B. Smith,* manager of engineering research and development, has been elected vice-president in charge of engineering, and *M. G. Shevchick,* secretary, has been elected also treasurer. *F. W. Dohring,* general sales manager, has been given added responsibilities as assistant to the executive vice-president.

◆

LIMA LOCOMOTIVE WORKS.—***Robert E. Briggs,*** **assistant shop engineer, has been** appointed shop engineer of the Lima Locomotive Works, to succeed the late W. N. McConkey. *Ivan B. Wagner* has been appointed senior assistant shop engineer, and *Henry Wagner, Jr.,* assistant shop engineer.

Robert E. Briggs is a graduate of Ohio State University (1934). He formerly was employed in the Packard Electric division of the General Motors Corporation, Warren, Ohio, and was process engineer there when he resigned in 1937 to become industrial engineer at the Berger Manufacturing division of the Republic Steel Corporation, Canton, Ohio. He was appointed plant engineer in 1940. In 1942 he joined the Lima Locomotive Works as assistant shop engineer.

Ivan B. Wagner has been in the electrical department of the Lima Locomotive Works for the past 28 years and has been chief electrician for 19 years.

Henry Wagner, Jr., was in the employ of the American Locomotive Works at Pittsburgh, Pa., before joining the Lima shop engineering department 28 years ago.

◆

PITTSBURGH STEEL FOUNDRY CORPORATION.—*G. D. Thompson,* chairman of the board of directors of the Pittsburgh Steel Foundry Corporation, Glassport, Pa., has

G. D. Thompson

been elected president of the company. Mr. Thompson has been a director of the company for the past six years. He was elected chairman in 1942. He attended the Carnegie Institute of Technology and was at one time production manager of the Westinghouse Electric & Manufacturing Company. Subsequently, he was president of the Thompson & Taylor Company and president of the 535 Fifth Avenue Corp.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—*Ellis L. Spray* has been elected vice-president in charge of elevator and air conditioning activities of the Westinghouse Electric & Manufacturing Co., at Jersey City, N. J. The Westinghouse Electric Elevator Company, which was a wholly owned subsidiary of the Westinghouse Electric & Manufacturing Co., has been dissolved and will continue as the Elevator and Air Conditioning divisions of Westinghouse. Mr. Spray had been vice-president and general manager of the Elevator Company.

◆

ALLIED RAILWAY EQUIPMENT COMPANY.—*Carl R. Moline,* whose election to vice-president of the Allied Railway Equipment Company, with headquarters at Chicago,

Carl R. Moline

as reported in the April *Railway Mechanical Engineer,* was born at Ft. Madison, Iowa, on April 23, 1910. He is a graduate of the University of Iowa, and became a design engineer in the employ of the Goss Printing Press Company at Chicago in 1937. In 1939 he went with the Ajax Hand Brake Company and in September, 1940, resigned to become associated with the Allied Railway Equipment Company. On January 1, 1942, he was appointed to chief engineer, in which position he also continues.

◆

UNION ASBESTOS & RUBBER COMPANY.—*George A. Hull,* vice-president of the Union Asbestos & Rubber Co., and general manager of the firm's Equipment Specialties division, with headquarters at Chicago, has been transferred to Los Angeles, Calif., where he will supervise special work in engineering and sales of specialties for refrigerator cars and other railroad equipment. Mr. Hull will retain his titles and continue his previous duties.

◆

STANDARD OIL COMPANY OF NEW JERSEY.—*Joseph F. Hoerner,* formerly New York district sales manager for the Baldwin Locomotive Works, has joined the railroad sales department of the Standard Oil Company of New Jersey.

◆

BENDIX AVIATION CORPORATION. — The Bendix Radio division of the Bendix Aviation Corporation has expanded its west coast quarters at North Hollywood, Calif., to provide complete shop facilities for the assembly and production of special equipment, mock-ups and experimental radio installations for aircraft, railroad, marine and other applications

◆

PRESSED STEEL CAR COMPANY.—*Ernest Murphy,* vice-president in charge of operations, has been elected president of the Pressed Steel Car Company to succeed *John F. MacEnulty,* who becomes vice-chairman of the board of directors. The sales department will continue under the direct jurisdiction of Mr. MacEnulty.

◆

FAFNIR BEARING COMPANY.—*Fayette Leister* has been appointed engineering manager of the Fafnir Bearing Company, New Britain, Conn. Mr. Leister joined the Fafnir staff in 1921 as a sales engineer and for the past 10 years has been manager of the Detroit, Mich., territory. As engineering manager he will have charge of all phases of product design and development, testing and research, engineering data and service engineering.

◆

L. C. CHASE & CO.-GOODALL COMPANY.—L. C. Chase & Co. has been consolidated with the Goodall decorative fabrics division of the Goodall Company, to be known as Goodall Fabrics. The following appointments have been announced: *Paul E. Carr* has been appointed general manager. Mr. Carr joined L. C. Chase & Co. in 1940 as manager of the woolen division and for the past two years has been assistant general manager. *George B. Ogan* will continue with the company in a consulting capacity. *Jud E. Williams* has been appointed sales manager. Mr. Williams has been general manager of the Goodall decorative fabrics division since 1940.

◆

GENERAL ELECTRIC COMPANY.—*T. F. Barton,* commercial vice-president of the General Electric Company, has announced several organization changes within the New York district. *G. H. Reid* has been appointed assistant district manager. *W. E. Brown* has relinquished his position as manager, Central Station division, but will remain to handle special assignments. *H. M. Sliter* has been appointed district manager. *Horace Zimmer* district manager, Transportation Division, has been appointed also district manager of the Industrial division. *H. M. Bardin* is manager of sales of the Federal and Marine section which has been transferred from the Transportation to the Industrial division. *R. B. Ranson* has been appointed manager of the New Haven, Conn., office, and *J. J. Pascher* will manage the Hartford, Conn., office. *R. M. Darrin* has been appointed district manager, transportation division, New York district.

◆

HARRINGTON-WILSON-BROWN COMPANY.—*David F. Robinson,* recently granted inactive status from his assignment as lieutenant commander in the Navy Department, has joined Harrington - Wilson - Brown Company, with headquarters in New York. Prior to entering the service, Mr. Robinson had been associated for 13 years with William Sellers & Co., Philadelphia, Pa.

CLIMAX MOLYBDENUM COMPANY.—*R. L. Heath,* formerly chief metallurgist of the Allison division of the General Motors Corporation at Indianapolis, Ind., has been appointed metallurgical engineer of the Climax Molybdenum Company, with headquarters in St. Louis, Mo.

◆

CHAMBERSBURG ENGINEERING COMPANY.—*Commander R. E. W. Harrison* has rejoined the Chambersburg Engineering Company as vice-president in charge of sales, following his release to inactive duty by the Secretary of the Navy after four years of service as a staff officer in various bureaus and offices of the Navy Department.

◆

AMERICAN WELDING COMPANY.—The Carbondale, Pa., plant of the American Welding Company, wholly owned subsidiary of the American Car and Foundry Company has been closed and is now being offered for sale.

◆

RANSOME MACHINERY COMPANY.—*Carl F. Oechsle* has been appointed vice-president in charge of sales of the Ransome Machinery Company of Dunellen, N. J., a subsidiary of the Worthington Pump and Machinery Corporation.

◆

SYMINGTON - GOULD CORPORATION.—The Overland Supply Company, 116 New Montgomery Street, San Francisco, Calif., has been appointed sales representative of the Symington-Gould Corporation.

◆

AMERICAN BRAKE SHOE COMPANY.—*T. W. Pettus,* executive vice-president, has been appointed president of the National Bearing division of the American Brake Shoe Company.

Obituary

GARTH GRIFFITH GILPIN, vice-president in charge of engineering of the Standard Railway Equipment Manufacturing Company, Chicago, whose death on February 25 was announced in the April *Railway*

Garth G. Gilpin

Mechanical Engineer, was born at Portland, Ind., on October 3, 1882. He was a graduate of Purdue University with a degree in mechanical engineering. Mr. Gilpin spent two years in mining engineering and then became a draftsman, serving first the Wisconsin Central and later the Pennsylvania. In 1910 he became chief draftsman for the Chicago, Burlington & Quincy. He resigned in 1918 to join the staff of the W. H. Miner Company as a sales engineer and later became associated with the Standard Railway Equipment Manufacturing Company as chief engineer. In 1917 he was appointed vice-president in charge of engineering. Mr. Gilpin invented many devices for railway cars. His death occurred while vacationing in Arizona.

◆

ALEXANDER TURNER, vice-chairman and director of the National Bearing Metals Corporation, died March 20. Mr. Turner was 77 years of age. He was in the employ of the Wisconsin Central from 1886 to 1899, as a locomotive fireman, traveling fireman, locomotive engineman and road foreman of engines. From 1899 to 1909 he was with the Galena Signal Oil Company; from 1913 to 1927 was vice-president of the Bronze Metal Company, and in 1927 was elected vice-chairman and director of the National Bearing Metals Corporation.

◆

ROBERT C. MCCLOY, southeastern sales manager of the Taylor-Wharton Iron & Steel Co., died March 8. Mr. McCloy, who was 74 years of age, had been in charge of the company's Philadelphia, Pa., office where he maintained his headquarters. He had been associated with Taylor-Wharton in various sales capacities for 58 years.

◆

BENJAMIN NIELDS, assistant vice-president of the National Malleable & Steel Castings Company, died February 26. Mr. Nields was 63 years of age. He was in charge of the company's New York sales office from 1909 to 1931, when he returned to Cleveland, Ohio, as assistant vice-president.

Personal Mention

General

C. R. RUSH, master mechanic of the Missouri Pacific at DeQuincy, La., has been appointed mechanical superintendent of the Southern district, with headquarters at St. Louis, Mo.

J. M. NIXON, general foreman of the Seaboard Air Line's shops at Wildwood, Fla., has been appointed superintendent, motive power, of the Macon, Dublin & Savannah, with headquarters at Macon, Ga.

C. P. SLACK, formerly electrical foreman of the Delaware, Lackawanna and Western at Scranton, Pa., has been appointed division electrical supervisor, covering all electrical work done on the railroad in the state of Pennsylvania. Mr. Slack will continue to make his headquarters in Scranton.

EDWARD C. KAISER, whose appointment as superintendent of motive power of the Lehigh & New England at Pen Argyl, Pa., was announced in the April issue, was born at Philadelphia, Pa., on January 20, 1899. Mr. Kaiser entered railroading in July, 1917, with the Reading. After holding various supervisory positions he became general foreman of the Reading's engine terminal at Philadelphia, the position he held at the time of his appointment as superintendent of motive power of the Lehigh & New England.

In Military Service

LT. COL. FAY L. KING, of Sabula, Ia., formerly district master mechanic of the Chicago, Milwaukee, St. Paul & Pacific, has been promoted to the rank of Colonel as announced by Maj. Gen. Frank S. Ross, chief of transportation, European Theater of Operations. Colonel King is in charge of the equipment division, 2nd Military Railway Service.

ANDREW HOPKINS, formerly assistant enginehouse foreman of the Chesapeake & Ohio at Hinton, W. Va., is now with Company B, 770th Railway Operating Battalion at Camp Claiborne, La., and is conducting air-brake classes for the road- and shop-men in that unit.

ROBERT R. SNEDDON, who has been appointed assistant superintendent equipment of the New York Central at Detroit, Mich., as noted in the April issue, was born on May 5, 1903, at Evansville, Ind. Mr. Sneddon is a graduate of the Mt. Carmel (Ill.) High School (1922). He became a machinist apprentice in the locomotive shops of the Cleveland, Cincinnati, Chicago & St. Louis (New York Central) at Mt. Carmel, on October 16, 1922; enginehouse and car foreman at Benton Harbor, Mich., on August 19, 1929; gang foreman at Indianapolis, Ind., on August 1, 1930; enginehouse foreman at Lafayette, Ind., on November 3, 1932; gang foreman at Indianapolis on January 1, 1933; special inspector at Indianapolis on July 1, 1933; gang foreman at Indianapolis on February 2, 1936; enginehouse foreman at Riverside shops, Cincinnati, Ohio, on October 1, 1937; and general foreman at Riverside on October 1, 1939. Mr. Sneddon was appointed assistant master mechanic at Detroit on July 1, 1941; master mechanic at Jackson, Mich., on November 1, 1942; assistant to superintendent equipment on September 1, 1943, and assistant superintendent equipment on January 1, 1945.

(*Turn to second left-hand page*)

Let's get *down to earth*

on train communication

"UNION"
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INDUCTIVE TRAIN COMMUNICATION

Dependable voice communication

"Union" I.T.C. (Inductive Train Communication) system provides dependable, practicable two-way voice communication between vehicles of a train, between trains, and between trains and wayside points.

It is a train communication system designed exclusively for railroad use, by men who know railroad needs, and proved through years of regular railroad service.

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"Union" Inductive Train Communication is a system of voice communication *designed exclusively for railroad use.* It utilizes for transmission two elements commonly found on railroads—the tracks and the adjacent line wires.

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Thus, installations of "Union" I.T.C. equipment involve no new structures. It's a job that existing departments can handle with a minimum of outside supervision. If your railroad has rails and a pole line, you're well on your way toward easy installation of "Union" I.T.C.

Ease of installation is one more reason why railroads interested in dependable train communication are finding that *"Union" I.T.C. is the answer.*

Full information will be furnished without obligation by our nearest district office.

UNION SWITCH & SIGNAL COMPANY

SWISSVALE PENNSYLVANIA

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO

C. L. HALL has been appointed assistant supervisor of Diesel locomotive maintenance of the New York Central, with headquarters at New York.

Car Department

F. C. FYE, assistant engineer car construction of the Union Pacific at Omaha, Neb., has been advanced to the position of general car inspector, northwestern district and Idaho division to and including Pocatello, with headquarters at Pocatello, Idaho.

RALPH O. WILLIAMS, car foreman of the Union Pacific at Nampa, Idaho, has been promoted to the position of general car inspector, south-central district, with headquarters at Salt Lake City, Utah.

Master Mechanics and Road Foremen

ORA O. STERNE has been appointed road foreman of engines of the Baltimore & Ohio, with jurisdiction over the territory between Grafton, W. Va., Richwood and Charleston. Mr. Sterne's headquarters are at Grafton.

L. M. CORNELL, general foreman of the Atlantic Coast Line at High Springs, Fla., has been appointed acting master mechanic at Waycross, Ga., replacing T. B. Dobbins, who has been granted a leave of absence on account of illness.

Shop and Enginehouse

F. L. HENIG, general foreman, locomotive department, of the Missouri Pacific at Little Rock, Ark., has been appointed acting superintendent of shops, with headquarters at Little Rock.

A. HUBENER, superintendent of shops of the Missouri Pacific, with headquarters at Little Rock, Ark., has been granted a leave of absence because of illness.

Obituary

HARRY W. RIDGWAY, who retired in 1936 as superintendent of motive power of the Colorado & Southern, died in a Denver, Colo., hospital on March 17. Mr. Ridgway was born at Delaware Water Gap, Pa., on July 17, 1866, and entered railway service in November, 1881, as a mechanical apprentice on the Denver & Rio Grande Western. He served in various capacities in the mechanical department of this company and of the Mexican Central until 1901 when he was appointed superintendent of machinery of the El Paso & Northeastern (now part of the Southern Pacific). Later he was appointed superintendent of the contract shop. In 1904 he returned to the Mexican Central as superintendent of shops at Agua Caliente, Mex., and from 1906 to 1913 served as master mechanic on the Colorado & Southern and the Atchison, Topeka & Santa Fe at Denver. At the end of this period he was appointed superintendent of motive power of the C. & S. From 1924 to 1932 Mr. Ridgway also served as assistant to the superintendent of motive power of the Chicago, Burlington & Quincy.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

"BETTER PRODUCTS WITH ELECTRIC WELDED TUBING."—Formed Steel Tube Institute, Keith building, Cleveland 15, Ohio. A 32-page book compiled to bring to engineers and product designers a new conception of electric welded tubing. Contains specifications for various tubing applications and illustrations both of wartime and peacetime uses.

◆

MICRO SWITCHES.—Micro Switch Division, Freeport, Ill. 100-page illustrated catalog, No. 71. Describes, by sections, Micro switches with A-N part numbers, basic Micro switches, die cast and aluminum housings, peanut Micro switches and auxiliary actuators.

◆

ENGINEERING DATA.—Cincinnati Milling and Grinding Machines, Inc., Cincinnati, Ohio. Engineering bulletin M-1322 contains dimensional drawings and specifications of their several types of milling and broaching machines. Photographs of the machines uniformly placed on the pages serve as a visual index to the data. Included also are data and drawings of several attachments used with these machines.

◆

AIR DIFFUSION.—W. B. Connor Engineering Corp., New York, 74-page catalog, "Kno-Draft Adjustable Air Diffusers." Essentially an engineering handbook showing the sketches, charts, instructive tests and dimension prints to furnish the engineering data necessary for the proper application and performance of air diffusers.

◆

ELASTIC STOP NUT CORPORATION.—*John R. Munn*, chairman of Munn & Steele, Inc., has been elected president of the Elastic Stop Nut Corporation to succeed W. T. Hedlund, who died November 29. Mr. Munn, who was a director of Elastic Stop Nut, will serve for the unexpired term of his predecessor and until his successor is elected.

◆

FLOATLESS LIQUID LEVEL CONTROLS.—The B/W Controller Corporation, Birmingham, Mich. Twenty-eight-page illustrated catalog No. 145 covering floatless liquid level and industrial controls. The floatless controls employ fixed electrodes in the liquid and are featured as being free from troubles caused by ice.

◆

SCREW THREAD FITS.—Greenfield Tap and Die Corporation, Greenfield, Mass. "Guide to Screw Thread Fits" presents in concise and graphic form essential data on screw thread fits. Each size of screw thread—NC and NF sizes from No. 3 machine screw through 1 in.—is covered on a single page.

◆

"QUALITY CONTROL" HANDBOOK.—Continental Machines, Inc., 1301 Washington avenue South, Minneapolis 4, Minn. A pocket size book on scientific inspection through controls offered by DoAll gages and gage instruments, with photographs, diagrams, charts and conversion tables.

◆

BUSHING PRESSES. — Watson-Stillman Company, Roselle, N. J. Bulletin 520-A descriptive of a line of self-contained, quick-acting, oil-operated presses for inserting and removing connecting-rod bushings, driving-box brasses, etc., and for bending or straightening rods, levers, etc.

◆

WELDING EQUIPMENT.—The Victor Equipment Company, San Francisco, Calif. 104-page catalog of Victor gas-welding and cutting equipment. Data cover various types of welding and cutting torches, cutting attachments, cylinder manifolds, regulators, etc. One page carries a welding torch, tip and nozzle selection chart which shows the tip size, flame length, pressures and hourly gas consumption required for various metal thicknesses.

◆

SEAM AND ROLL SPOT WELDING MACHINES.—Sciaky Bros., 4915 West Sixty-Seventh Street, Chicago. Bulletin No. 113-A illustrates and describes Series PMM.1 180 KVA seam and roll spot welding machines for mild steels, stainless steels, and non-ferrous alloys. Contains also tooling data and machine specifications.

◆

MACHINE GAS CUTTING TIPS.—Air Reduction Sales Company, 60 East Forty-second street, New York 17. Twelve-page, four-color bulletin, No. ADG-2008, describes Airco "45" and "45M" high-speed machine gas cutting tips which control the expansion of cutting oxygen. Illustrated with cross-sectional drawings and photographs.

◆

CUTTING TOOLS.—Chicago-Latrobe Twist Drill Works, 411 West Ontario Street, Chicago 10. Six-page leaflet entitled "Cutting Tools for Efficient Operations." Gives information as to range of sizes and the adaptability of various types of Chicago-Latrobe drills.

◆

VARNISHES.—Dow Corning Corporation, P. O. Box 592, Midland, Mich. Eight-page booklet describes the properties of DC 993 varnish and outlines the recommended procedure in applying this silicone product to the insulation of electrical equipment.

◆

MAGNETO IGNITION CATECHISM.—Fairbanks, Morse & Co., Beloit Works, Beloit, Wis. A 64-page illustrated book devoted to the subject of fundamentals of magneto ignition. Contents include such subjects as definition of magneto, its general purposes, magnetism and electricity, ignition requirements, early ignition systems, magneto design and construction, application of magneto ignition, impulse couplings and their use, and magneto service practices.

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Railway Mechanical Engineer

June 1945

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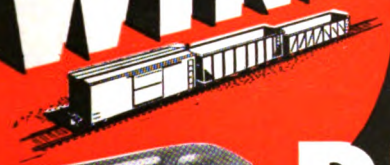
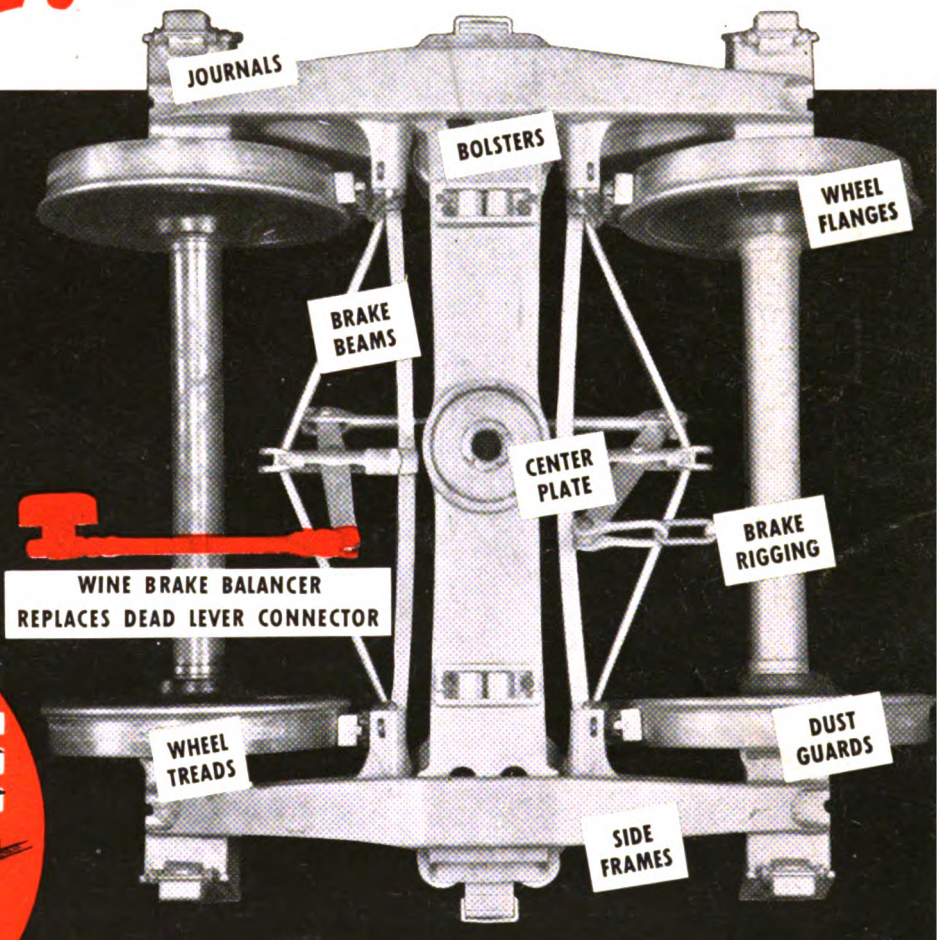
AT ALL FRICTION
POINTS

Specify WINE

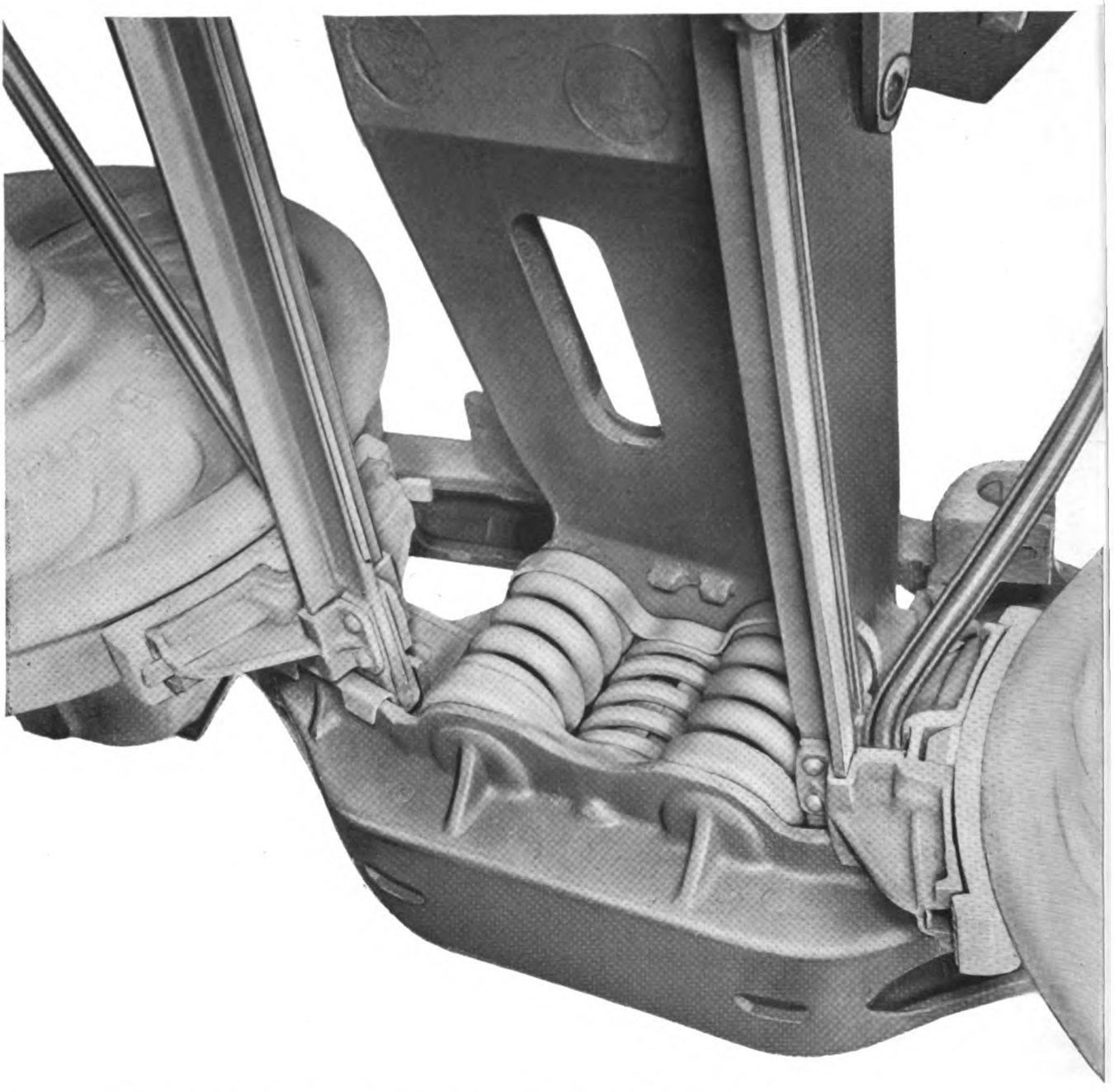




BRAKE BALANCER

THE WINE RAILWAY APPLIANCE CO.,
TOLEDO 9, OHIO

UNIT TRUCK



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RAILWAY MECHANICAL ENGINEER

(Name Registered, U. S. Patent Office)
With which is incorporated the RAILWAY ELECTRICAL ENGINEER.

Founded in 1832 as the American Rail-Road Journal

Roy V. Wright
Editor, New York

C. B. Peck
Managing Editor, New York

A. G. Oehler
Electrical Editor, New York

E. L. Woodward
Western Editor, Chicago

H. C. Wilcox
Associate Editor, New York

J. L. Stover
Associate Editor, New York

Robert E. Thayer
Vice-Pres. and Business Manager, New York

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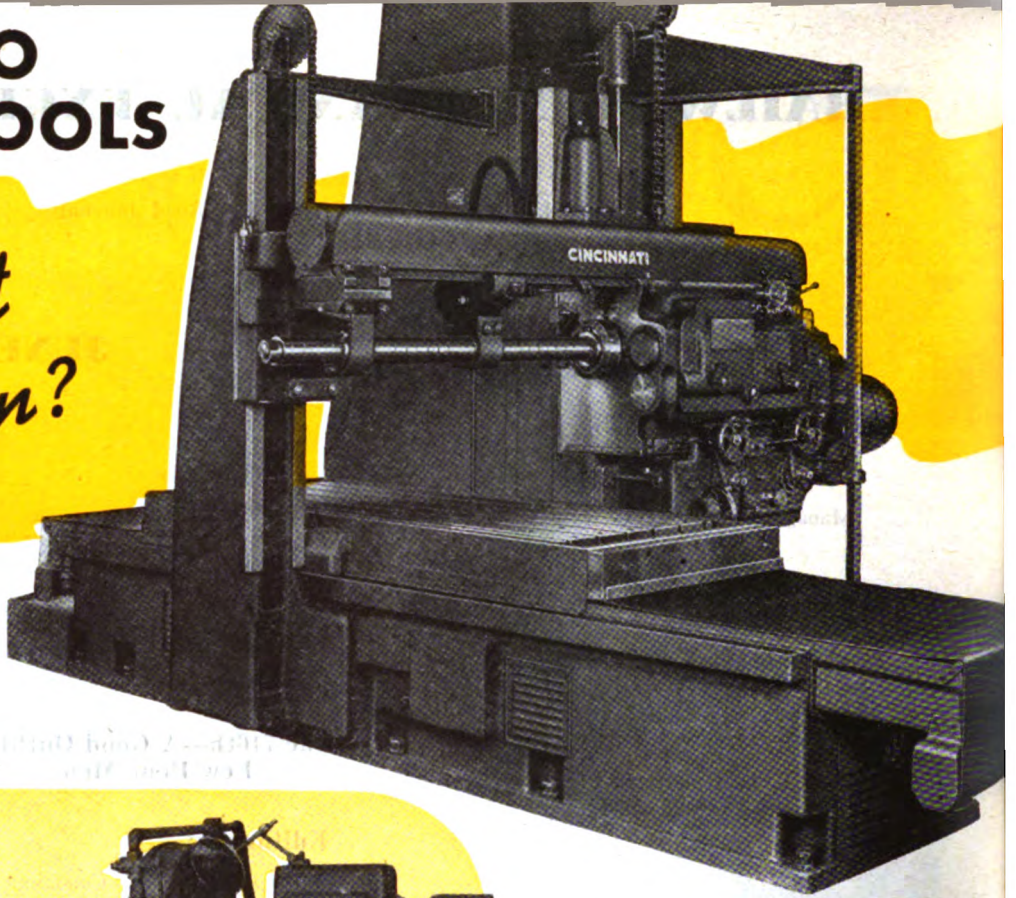
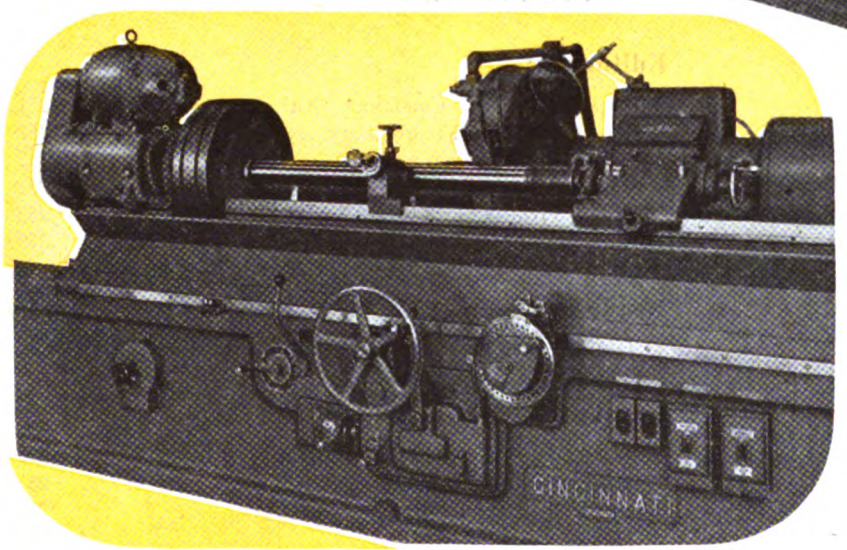
HOW DO MACHINE TOOLS *help meet competition?*



Below—CINCINNATI Piston Rod Grinding Machine. For 35" diameter of piston, maximum length 144" Catalog G-491-2



Above — CINCINNATI 36" Series Horizontal Hydro-Tel Milling Machine. Has finger-tip control for easy and accurate adj ment of work to cutter, 72" or 120" table tra 18" cross travel, 48" vertical travel. Catalog M-12

The competitive struggle with bus and lines for freight and passenger traffic will so be back again, and it will be keener than e before. Of the many ways to meet this co petition, new and modern machine tools an important consideration.

elow—CINCINNATI No. 2 Cutter and Tool rinder. For sharpening a wide variety of illing cutters, taps, reamers, shaper tools, lc Catalog M-962-2

For example, the *repair parts* needed for fast express and passenger locomoti *must be ready on time*. You can't afford to tie up rolling stock because of t inadequacy of a machine tool . you can't afford the delay of a break-do on the road.

Refinements in the design of locomotives and accessory equipment *call for clo accuracy*. Higher speeds mean closer accuracy of all sliding and rotating par

Cost of machining must be reduced still further Semi-automatic machines c be tooled up with simple fixtures for several types of work, often replacing t and sometimes three older machines.

CINCINNATI Milling, Grinding, and Cutter Sharpening Machines go a long w toward meeting the requirements outlined above. Three types of these machir are illustrated here Many other types are also available, all of which are illu trated in general catalog M-995-3 Write for literature, or ask for a visit by o of our field engineers

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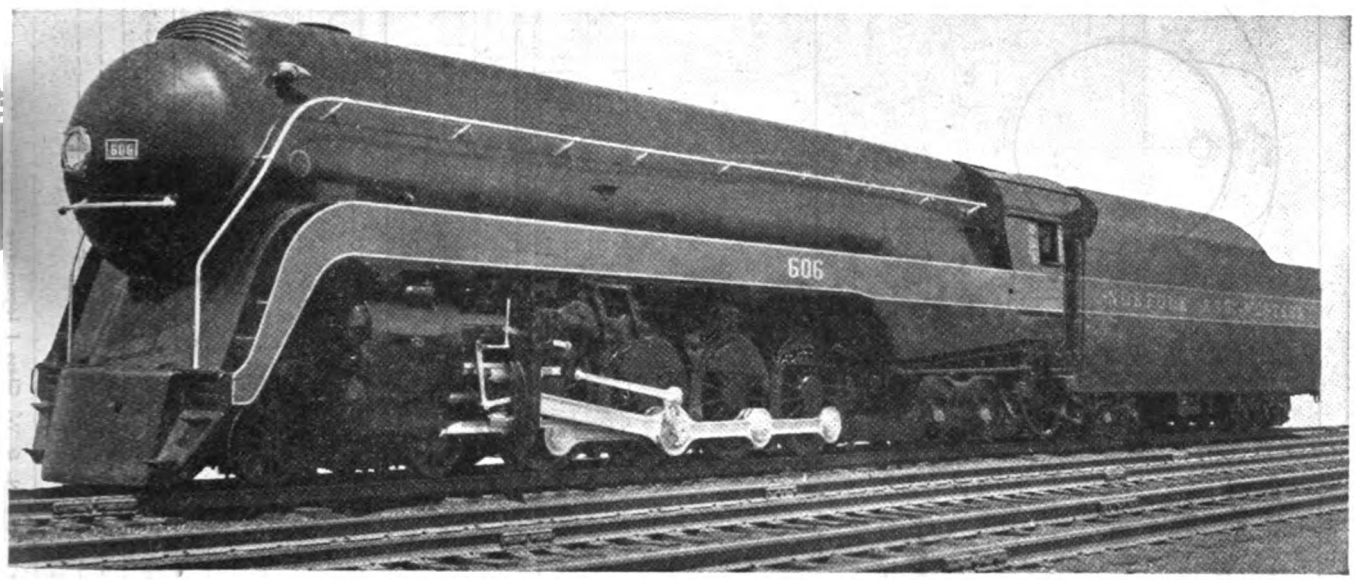
THE CINCINNATI MILLING MACHINE CO. CINCINNATI, OHIO, U. S.

TOOL ROOM AND MANUFACTURING MILLING MACHINES...SURFACE BROACHING MACHINES...CUTTER SHARPENING MACH

N. & W. Class J 4-8-4 Locomotives



Modern passenger locomotives take advantage of boiler capacity, roller bearings and unusual lubrication capacity to run high mileages at low cost

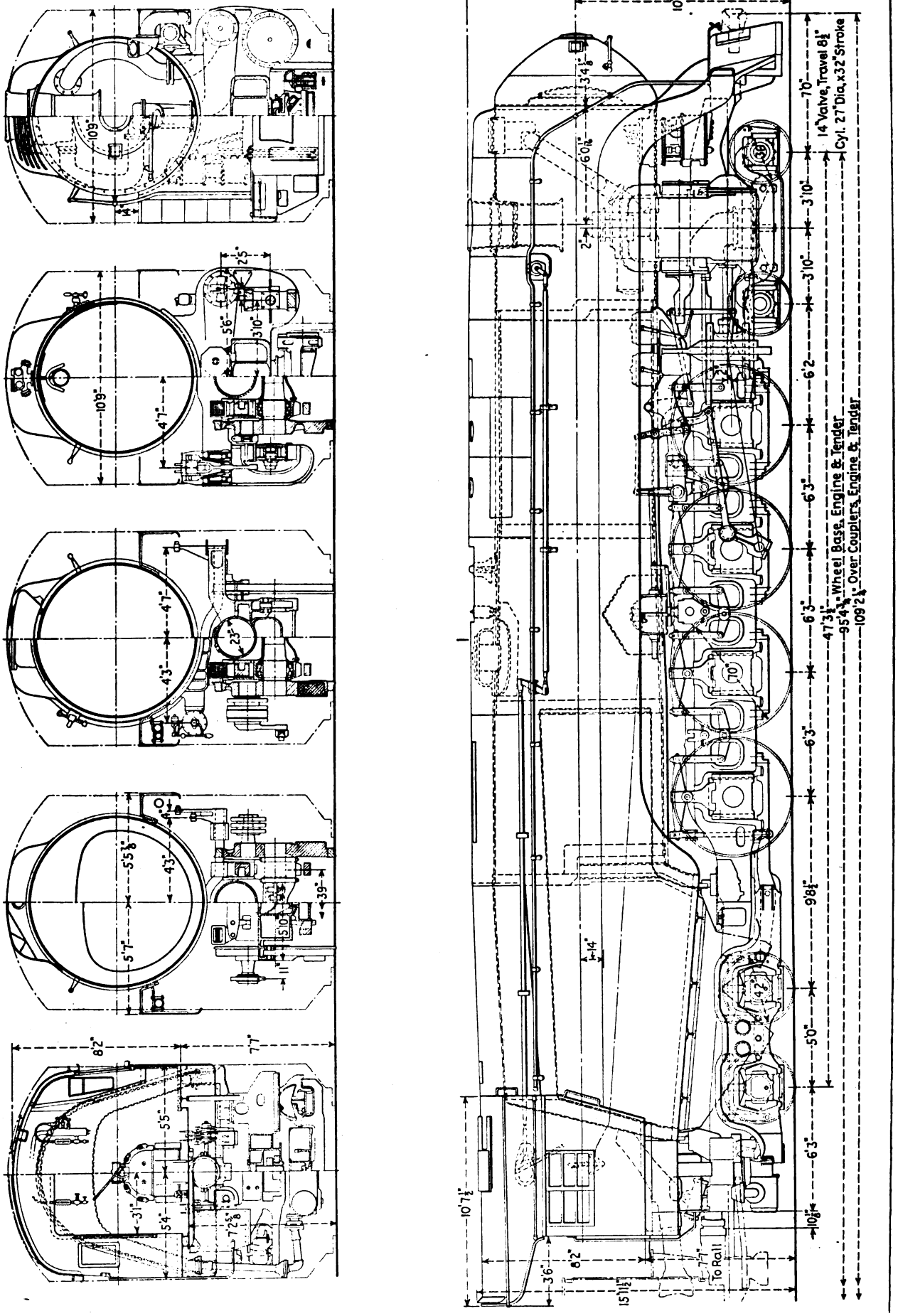
In October, 1941, the first of the Class J 4-8-4 type passenger locomotives went into service on the Norfolk & Western. There are now a total of 11 of this type being used in main-line passenger service handling heavy trains between Norfolk, Va., and Cincinnati, Ohio, as well as between Monroe, Va. (the junction with the Southern) and Bristol. The Class J locomotives bear the road numbers 600 to 610 and were built in the N. & W. shops at Roanoke, Va. They have a tractive force of 73,300 lb., 275 lb. boiler pressure, 70-in. drivers and a total engine weight of 494,000 lb. The weight on drivers is 288,000 lb. The tenders, carried on six-wheel trucks have a coal capacity of 35 tons and 20,000 gals. of water. Roller bearings are used on all axles, crank pins, crosshead pins, and on the valve gear. The boilers have a combined heating surface of 7,448 sq. ft. and a grate area of 107.7 sq. ft. The drawbar horsepower is in excess of 5,000.

In designing these locomotives the objective was to develop a steam motive power unit that would be capable of making long engine runs with a minimum of servicing and repairs; that would have sufficient hauling capacity to handle the heavy tonnage passenger trains that are a normal part of the N. & W.'s business over heavy mountain grades at relatively high speeds and, above all, perform this work at a cost lower than that which has been acceptable as steam locomotive operating cost for many years. Many of the design characteristics of the locomotive itself contribute to all three of these objectives but outstanding among the factors that enable this power to do its present job are boiler capacity, roller bearings and mechanical lubrication.

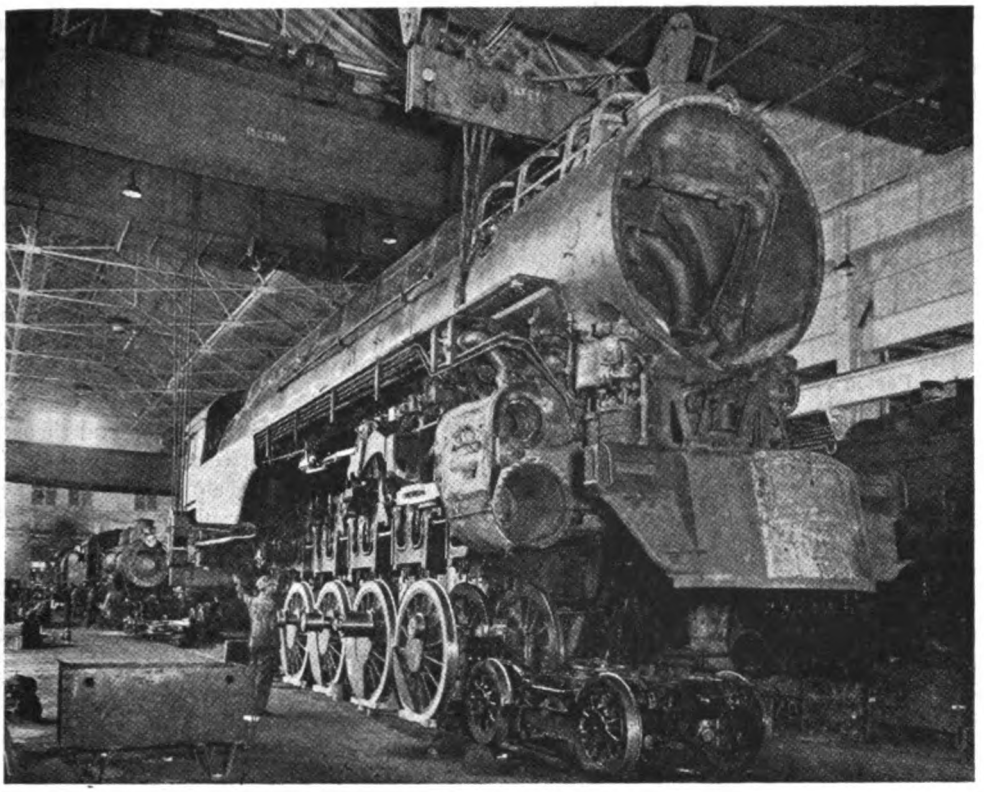
Since 1936 the Norfolk & Western has built a total of 116 locomotives with roller bearings and their value, in freight service particularly, shows up in the fact that, during the first six months of 1944 the roller bearing equipped locomotives representing 33 per cent of the freight locomotive inventory was making 68 per cent of the total steam freight mileage.

Coincident with the program to reduce both road and terminal delays by the use of roller bearings considerable study was given the matter of lubrication, with both oil and grease. Every locomotive part in which friction is a factor was carefully studied with a view either to using an anti-friction bearing, or improving the lubrication of that part in such a manner that service failures would be a remote possibility and maximum service life could be assured.

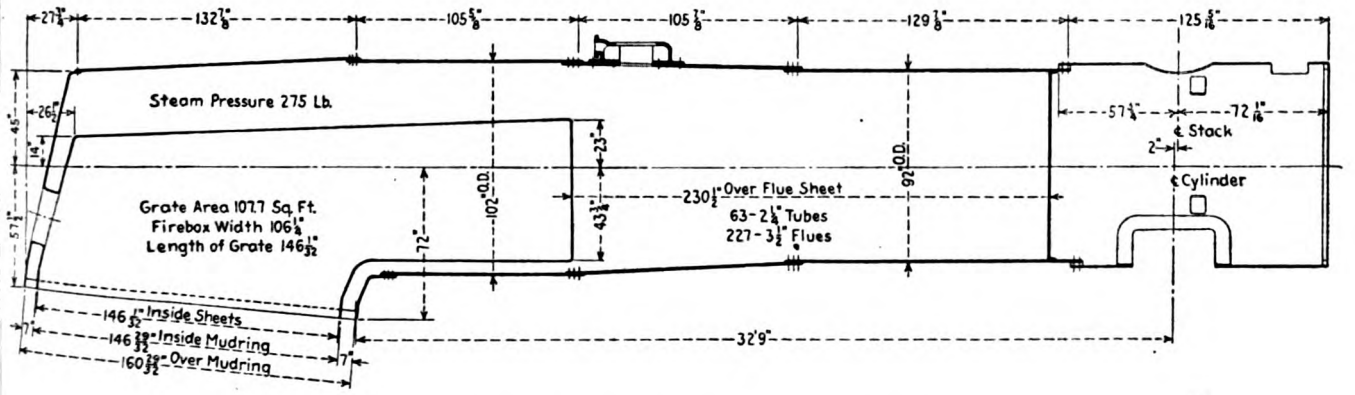
The results of this study in the matter of increasing the usefulness of the steam locomotive are to be seen in two



Cross-section and elevation of the N. & W. Class J locomotive



Wheeling one of the Class J's in the erecting shop



General Dimensions and Proportions of the Boiler

Steam pressure, lb.	275
Diameter first ring, inside, in.	89⅞
Diameter first ring, outside, in.	92
Diameter second ring	Conical
Diameter third ring, inside, in.	100¼
Diameter third ring, outside, in.	102
Sheet thickness, in.:	
Smokebox	5/8
First ring	1 1/16
Second ring	1 3/16
Third ring	7/8
Back head	½
Side sheets	½
Roof sheet	7/16
Furnace door sheet	3/8
Furnace side sheets	3/8
Furnace crown sheet	3/8
Combustion chamber	3/8
Front tube sheet	¾
Back tube sheet	½
Firebox length, in.	146 1/32
Firebox width, in.	106¼
Water space, front, in.	7
Water space, back, in.	7
Water space, sides, in.	7
Combustion chamber length, in.	103¼
Arch tubes, number and diameter	(5) 3½
Syphons, number and location	None
Tubes, number and diameter	63-2¼
Flues, number and diameter	227-3½
Length over tube sheets, ft.-in.	19-2½
Net gas area through tubes and flues, sq. ft.	10.8

Superheater, type	E
Fuel	Bituminous
Grate area, sq. ft.	107.7
Stoker, type	Standard HT
Feedwater heater, type	Worthington 6SA
Heating surfaces, sq. ft.:	
Firebox and combustion chamber	518
Arch tubes	60
Firebox, total	578
Tubes and flues	4,693
Evaporative, total	5,271
Superheater	2,177
Combined evap. and superheat.	7,448
Boiler proportions:	
Firebox heat. surf., per cent comb. heat. surf.	7.76
Tube-flue heat. surf., per cent comb. heat. surf.	63.0
Superheat surf., per cent comb. heat. surf.	29.2
Firebox heat. surf. ÷ grate area	5.36
Tube-flue heat. surf. ÷ grate area	43.6
Evap. heat. surf. ÷ grate area	48.9
Superheat. surf. ÷ grate area	20.2
Comb. heat. surf. ÷ grate area	69.2
Gas area ÷ grate area	0.10
Tractive force ÷ grate area	680.5
Weight of engine ÷ evap. heat. surf.	93.7
Weight of engine ÷ comb. heat. surf.	66.3
Tractive force ÷ evap. heat. surf.	13.9
Tractive force ÷ comb. heat. surf.	9.84
Tractive force × diameter drivers ÷ comb. heat. surf.	688.9

classes of locomotives designed and built by the N. & W. at its Roanoke, Va., shops—the Class A 2-6-6-4 type simple articulated and the Class J 4-8-4 type. In both of these designs mechanical lubrication and pressure has been utilized to the utmost. On the Class A locomotive a total of 336 points are lubricated—238 by oil from mechanical lubricators and 98 from grease through pressure fittings. Details of the lubrication of the Class J are to be found elsewhere in this article.

Detailed performance records compiled in connection with two of the Class A locomotives showed that in 87 months they made a total of 1,310,319 miles for a daily average (serviceable days) of 285 miles and that the maintenance cost was 21.12 cents per locomotive miles and $2.02 per million tractive-force pound miles. During this time the locomotives were available for service 62.9 per cent of the potential hours.

Table I—Comparison of Performance, Class J and Class K Locomotives — Two Locomotives of Each Class Over a Period of 36 Months

	Class J		Class K-a	
	Hr.	Min.	Hr.	Min.
Time in shop	4,019	16	7,741	10
M.P. turning time	11,326	28	7,517	51
Total time unserviceable	15,345	44	15,259	01
Total C.T. delay	7,712	28	14,154	32
Total time at terminal	23,058	12	29,413	33
Total possible hours	52,608	..	52,512	
Time available for service	37,262	16	37,252	59
Per cent availability	70.8		70.9	
Total time in service	29,549	48	23,098	27
Per cent time in service	56.2		44.0	
Total despatchments	4,095		2,261	
Total mileage	822,402		462,787	
Average daily mileage	412		253	
Total repair cost	$94,918.92		$72,594.74	
Repair cost per locomotive-mile, cents	11.54		15.69	

Similarly, two of the Class J locomotives showed a maintenance cost of 11.54 cents per locomotive-miles and $1.57 per million tractive-force pound miles over a period of 36 months and 822,402 miles of passenger service. The average for these two locomotives was 412 miles per serviceable locomotive day. These locomotives were available for service 70.8 per cent of the potential hours. A portion of the service record of these two locomotives and two Class K is shown in Table I.

Description of the Class J Locomotives

Boiler and Appurtenances

The boiler for the Class J locomotive is of the conical type 89⅞ in. inside diameter at the first course and 102 in. outside diameter at the third course. All of the sheets in the boiler are carbon steel. The barrel sheets are 1 1/16, 1 3/16 and ⅞ in. thick for the first, second and third courses, respectively, while the firebox sheets are ⅜ in. and ½ in. The front tube sheet is a flat ¾-in. plate welded to a ¾-in. by 4-in. ring which is riveted to the barrel. Braces of ¾-in. material are welded to the tube sheet and to the ring.

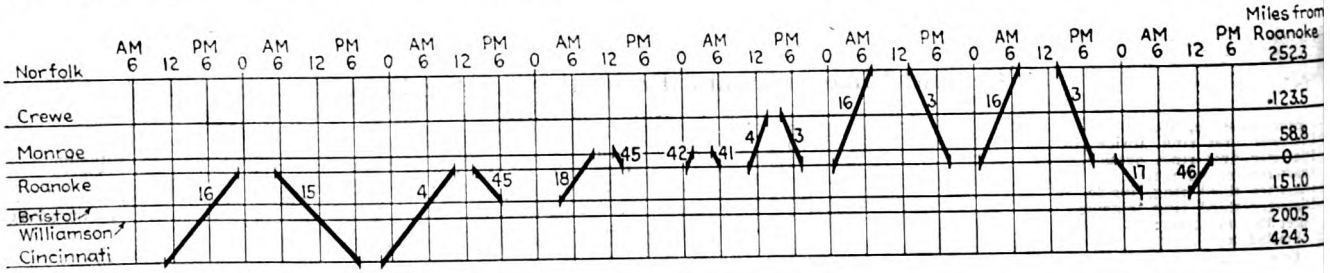
The firebox, 146 1/32 in. long and 106¼ in. wide is completely welded and has a grate area of 107.7 sq. ft. The boiler is designed for a working pressure of 275 lb. and is equipped with four 3½-in. safety valves. A full installation of flexible staybolts is used in the breaking zones of the sides, crown and back head as well as in the combustion chamber and throat sheets. The butt welded seam between firebox and throat sheets is reinforced by the welding of ½-in. by 3-in. rods across the seam at intervals providing additional stiffness to prevent flexure of the welded seam.

Bituminous coal is fed by a Standard HT stoker and the firebox is fitted with N. & W. standard grate equipped for power shaking with a steam grate shaker. The firedoor is the Franklin butterfly type No. 8. A Security brick arch is supported by five arch tubes 3½ in. diameter.

Water is supplied by a Nathan Type 4,000 injector and a Worthington Type 6-SA feedwater heater each having a capacity of 12,000 gal. per hr. The boiler has 227 superheater flues with a 115-unit Elesco Type E superheater and an American multiple-valve front-end throttle built into the header. Saturated steam, for the auxiliaries, is taken from the main dome through an auxiliary dry pipe to the main turret which is located

Table II—Assignment and Mileage of Class J Locomotives

No. of Locos.	Train Nos.	Territory	Mileage
2	4-15 and 16-3	Roanoke-Norfolk	1,008
8	3-16 and 15-4	Roanoke-Cincinnati	1,696
	17-46, 45-18, and 41-42	Roanoke-Bristol	906
	18-45 and 46-17	Roanoke-Monroe	232
	2/3 - 2/4	Roanoke-Williamson	402
Total daily mileage—10 locomotives			4,244
Average per locomotive			424
1	42 - 41	Roanoke-Monroe	116
	2/4 - 2/3	Roanoke-Crewe	248
Total daily mileage—11 locomotives			4,608
Average per locomotive			419



District	Train No.	Mileage	No. Cars
Cincinnati-Roanoke	16	424.3	11
Roanoke-Cincinnati	15	424.3	8
Cincinnati-Roanoke	4	424.3	14
Roanoke-Bristol	45	151.0	15
Bristol-Monroe	18	209.8	14
Monroe-Roanoke	45	58.8	14
Roanoke-Monroe	42	58.8	10
Monroe-Roanoke	41	58.8	13
Roanoke-Crewe	4	123.5	14
Crewe-Roanoke	3	123.5	9
Roanoke-Norfolk	16	252.3	14
Norfolk-Roanoke	3	252.3	9
Roanoke-Norfolk	16	252.3	17
Norfolk-Roanoke	3	252.3	12
Roanoke-Bristol	17	151.0	14
Bristol-Roanoke	46	151.0	15
Total loco. mileage (seven days)		3,368.3	

The runs made by one Class J locomotive in seven days' operation are plotted on the above chart—The details are shown in the table

outside of the cab. The main steam valve is located at the dome connection.

The shrouding effects a straight line flush with the top of the cab and conceals stack, bell, whistle, low water alarm, sand boxes, dome, turrets and feedwater heater. It also makes possible the concealment of the piping and, to carry out the clean external lines of the jacket and shrouding there is a 4⅝-in. by 9⅛-in. trough recessed into the left side of the smokebox to carry six pipes from the inside of the smokebox to the top of the boiler underneath the jacket.

Foundation and Running Gear

The engine bed is a General Steel Castings Corporation steel casting in which cylinders, back heads, guide and valve motion supports and cross members are cast as an integral part of the bed.

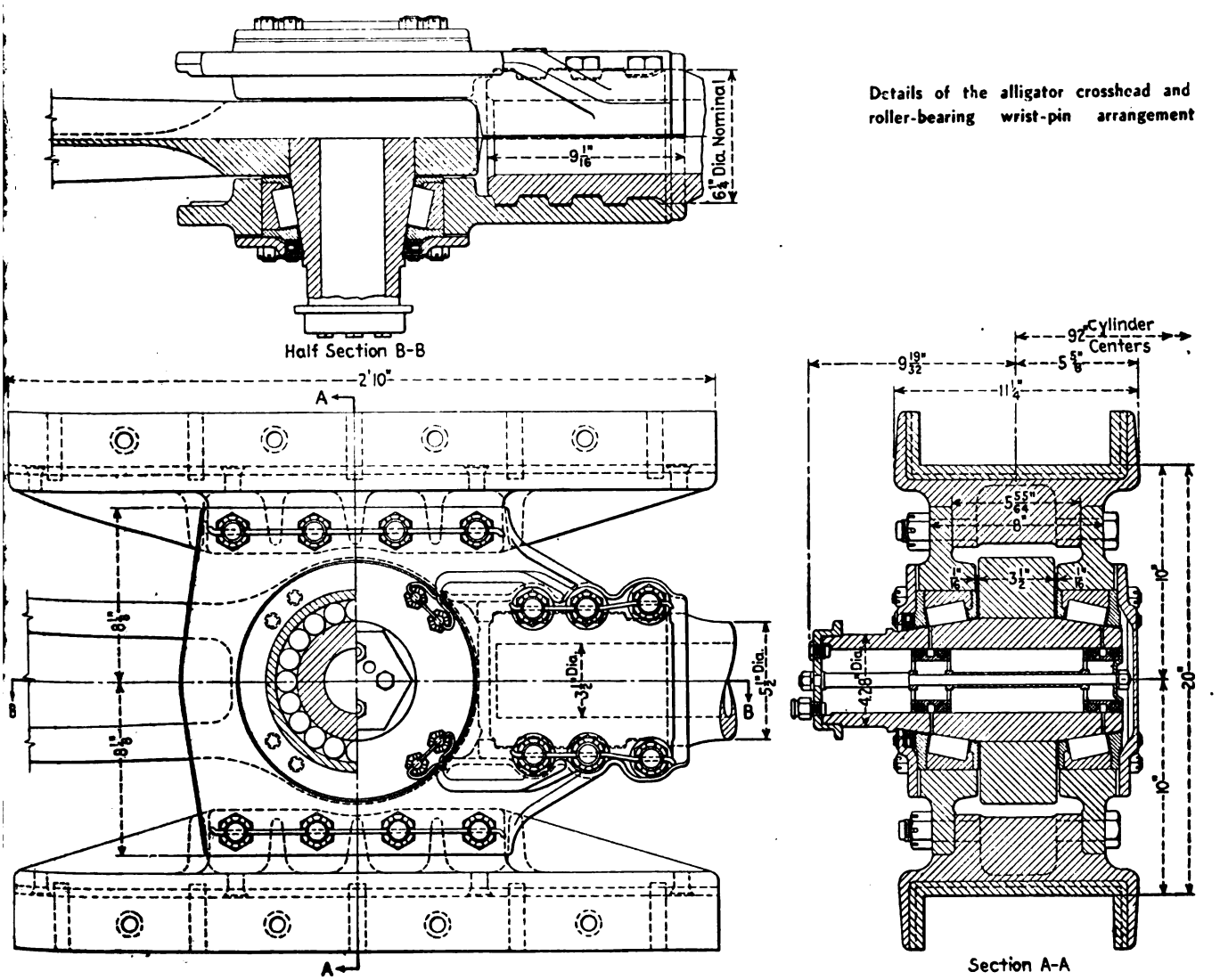
The spring rigging is the conventional equalizer and elliptic spring design with reverse camber driving springs. The equalization is continuous from the front of the No. 1 driver to the rear of the rear trailer wheel.

The engine truck is the General Steel Castings Corporation's constant resistance type with carbon steel axles, 36-in. steel tired wheels and Timken roller bearings. The journals are 7½ in. diameter. The Commonwealth trailer truck, supplied by the same manufacturer, is the outside bearing type with Timken roller bearings mounted on carbon steel axles having 8-in. journals. A Type E. Franklin booster is applied to the rear trailer axle of one locomotive. Both front and rear wheels are steel tired, 42 in. diameter, mounted on cast-steel centers.

The driving wheels have cast-steel centers with 70-in.

General Dimensions, Weights and Proportions of the Norfolk & Western 4-8-4 Type Class J Locomotives

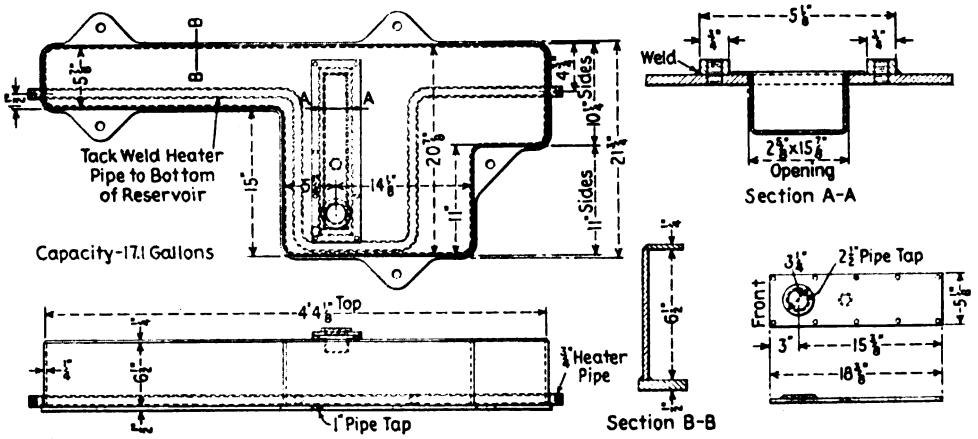
Road class	J
Road numbers	600-610
Builder	Company shops
Date built	1941, 1943
Steam pressure, lb. per sq. in.	275
Drivers, diameter, in.	70
Cylinders, number, diameter and stroke, in.	(2) 27 x 32
Rated tractive force, engine, lb.	73,300
Rated tractive force, booster, lb. (one locomotive)	12,500
Valve gear, type	Baker
Valves, piston, diameter, in.	14
Maximum travel, in.	8¼
Steam lap, in.	1⅝
Exhaust clearance, in.	3/16
Lead, in.	¼
Cut-off in full gear, per cent	82.0
Dimensions:	
Height, rail to top of stack, ft.-in.	16- 0
Height, rail to center of boiler, ft.-in.	10- 8
Width overall, ft.-in.	11-2
Length over engine and tender, ft-in.	109- 2¼
Cylinder centers, in.	92
Wheel bases, ft.-in.:	
Driving	18- 9
Rigid	18- 9
Engine, total	47- 3½
Engine and tender, total	95- 4¾
Weights, lb.:	
Front truck	101,600
Drivers	288,000
Trailer truck	104.400
Engine, total	494,000
Tender (loaded)	378,600
Weight on drivers, per cent weight of engine	3.93
Weight on drivers ÷ tractive force	58.2
Tender:	
Style or type	Rectangular
Water capacity, U. S. gal.	20,000
Fuel capacity, U. S. gal.	35
Trucks	Six-wheel



Details of the alligator crosshead and roller-bearing wrist-pin arrangement

Partial List of Materials and Equipment on the Norfolk & Western 4-8-4 Type Class J Locomotives

Engine bed; cylinders; tender underframe; pilot; engine and trailer trucks	General Steel Castings, Corp., Eddystone, Pa.
Tires; driving and trailer	Midvale Co., Nicetown, Pa.
Axles; engine and tender truck	J. R. Johnson & Co., Inc., Richmond, Va.
Driving axle; roller bearings on engine and trailer trucks; crankpins; side and main rods; crosshead; piston rod	**The Timken Roller Bearing** [illegible], Canton, Ohio.
Adjustable shoes; wedges; snubbers; radial buffer	Franklin Railway Supply Co., Inc., New York.
Pilot coupler	Buckeye Steel Castings Co., Columbus, Ohio.
Brake equipment	[illegible] Air Brake Co., Wilmerding, Pa.
Foundation brakes	American Brake Div. of Westinghouse Air Brake Co., Swissvale, Pa.
Sander	The Prime Manufacturing Co., Milwaukee, Wis.
Cylinder packing rings	American Hammered Piston Ring Div., Koppers Company, Baltimore, Md.



One of the 17-gallon auxiliary reservoirs used in connection with mechanical lubricators—These help make possible 1,300 miles of operation without replenishing engine and valve oil

Valve gear	The Pilliod Co., New York.
Whistle operating valve; bell ringer	Viloco Railway Equipment Co., Chicago.
Safety valves	Ashton Valve Co., Boston, Mass.
Blower valve	The Lunkenheimer Company, Cincinnati, Ohio.
Blow-off cocks; cylinder cocks; operating valves	The Okadee Company, Chicago.
Mechanical lubricators; boiler checks; injector; injector steam valves; injector checks and cut-off valves; water column; low water alarm	Nathan Manufacturing Co., New York.
Boiler and firebox steel	Worth Steel Co., Claymont, Del.
Boiler tubes; flues; arch tubes	National Tube Co., Pittsburgh, Pa.
Staybolt caps and sleeves	Flannery Bolt Co., Bridgeville, Pa.
Staybolt iron	Joseph T. Ryerson & Son, Inc., Chicago.
	Ulster Iron Works, Dover, N. J.
Brick arch	American Arch Co., Inc., New York.
Superheater	The Superheater Company, New York.
Throttle valve	American Throttle Co., New York.
Washout plugs	Huron Mfg. Co., Detroit, Mich.
Valve stem packing; piston rod packing	Paxton-Mitchell Co., Omaha, Neb.
Stoker	Standard Stoker Co., Inc., New York.
Feedwater heater	Worthington Pump and Machinery Corp., Harrison, N. J.
Tank hose strainer	T-Z Railway Equipment Co., Chicago.
Steam heat pressure regulator	The Leslie Co., Lyndhurst, N. J.
Air and steam gauges	Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Speed recorder	General Electric Company, Schenectady, N. Y.
Electric headlight equipment	The Pyle-National Company, Chicago.
Whistle	Hancock Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.
Flexible connections between engine and tender	Barco Manufacturing Co., Chicago.
Tender wheels	Armco Railroad Sales Co., Middletown, Ohio.
Tender truck roller bearings	SKF Industries, Philadelphia, Pa.

tires. The centers are mounted on carbon steel solid axles operating in Timken roller bearings. The main journal is 13½ in. diameter and the others are 12 9/16 in. diameter. The weight of the reciprocating parts of these locomotives is 1,547 lb., of which 35.6 per cent is balanced. The weight of the revolving parts is 2,747 lb. The overbalance is 175 lb. for the front, intermediate and back wheels and for the main wheels, 25 lb. The dynamic augment at 70 m.p.h. is 9,016 lb. for the front, intermediate and back wheels and 1,284 lb. at the main wheel. A speed of 140 m.p.h. would be required in order that the dynamic augment equal the static wheel load of 36,000 lb. The maximum sustained speed of the Class J locomotives handling 14 cars (1,000 tons) on level tangent track is 100 m.p.h.

The piston, rod and crosshead assembly is the Timken lightweight design. Five of these locomotives have multiple-bearing type, and six have alligator-type crossheads. The pistons are rolled steel with American sectional bronze-iron flanged packing. Both the alligator and multiple-bearing type crossheads have Timken forged steel centers, with roller bearing wrist pins and aluminum crosshead shoes.

The main and side rods are the Timken lightweight design with the main rod carrying the piston thrust to the No. 2 wheel. Tandem intermediate rods couple the main and intermediate wheels and single side rods couple the front and rear wheels to the main and intermediate wheels. All crank pins are Timken steel and operate in Timken roller bearings.

The distribution of steam is controlled by 14-in. piston valves having a travel of 8½ in. The valves are actuated by a Baker valve gear which in turn is controlled by an N. & W. Type BL power reverse gear. The back end of the eccentric rod is fitted with roller bearings.

These locomotives are equipped with mechanical lubricators having auxiliary oil reservoirs so that the total engine oil capacity is 28 gal. and the valve oil capacity is 22 gal. This is sufficient oil to run 1,300 miles without replenishment. The roller bearings on the crank and wrist pins have sufficient oil capacity to run 500 miles without replenishment; on extended runs these are replenished at station stops. The engine oil from the two 14-feed lubricators on the right side of the locomotive is distributed to a total of 208 points; 17 on the engine truck, 124 points on the driver pedestals, brake rigging and spring rigging, 13 points on the trailer truck and 28 points such as bell, guides, reverse shaft, radial buffer, stoker and boiler expansion bearings, and 26 points on the tender. The lubricator on the left side of the locomotive supplies valve oil for 12 points in the cylinders, valves, throttle stuffing box, air pumps, feedwater heater

Table III—Service Data for Five N. & W. Class J 4-8-4 Type Passenger Locomotives—From Date Built to First Shopping

	Maximum for one loco.	Minimum for one loco.	Average for five locos.
Accumulated mileage from date built to first shopping for general repairs	252,314	227,981	238,180
No. of possible days in above period	697	635	659
Mileage per day	372	352	361
No. of unserviceable days	52	34	43
Miles made each serviceable day	400	371	387
No. of times fire cleaned	138	72	103.2
Miles per fire cleaning	3,166	1,706	2,455
No. of despatchments	1,475	1,277	1,395
Despatchments per fire cleaning	19.3	10.4	14.4
Mechanical Parts Performance			
Cylinder packing rings, average mileage per renewal—right side	76,228	33,927	51,778
Cylinder packing rings, average mileage per renewal—left side	81,477	59,372	70,053
Piston rods, average mileage per regrounding—right side	56,995	42,052	47,636
Piston rods, average mileage per regrounding—left side	56,995	40,738	45,804
Crosshead shoes, average mileage per relining, right side	34,919	25,409	30,536
Crosshead shoes, average mileage per relining, left side	45,596	22,868	32,187
Tire Turning Mileages			
Engine truck, front wheels	24,939	20,099	23,351
Engine truck, rear wheels	63,078	43,952	49,621
Driving wheels	126,157	113,990	119,090
Trailer truck, front wheels	118,475	84,105	108,264
Trailer truck, rear wheels (without booster)	126,157	79,163	99,241
Trailer truck, rear wheels (with booster)	.....	74,811	.....
Tender wheels:			
No. 1 position	113,990	47,498	59,545
No. 2 position	126,157	61,108	85,064
No. 3 position	79,163	50,463	62,679
No. 4 position	84,105	45,596	54,132
No. 5 position	113,990	63,078	79,393
No. 6 position	118,745	61,108	79,393
Average for all positions	.....	.....	71,454
Engine Failures			
No. of failures charged to engine	2	1	1.4
Average mileage per engine failure	252,314	113,990	170,129
No. of engine failures charged to other causes	4	0	1.8
Average mileage, such failures	227,981	63,078	132,322
Total number of engine failures, five locomotives	.....	16	3.2
Average mileage per engine failure	237,490	50,463	74,431
Cost of classified repairs:			
Labor	$5,840.13	$5,210.20	$5,584.65
Material	7,687.80	2,981.82	4,765.78
Labor and material	13,527.93	8,192.02	10,350.45

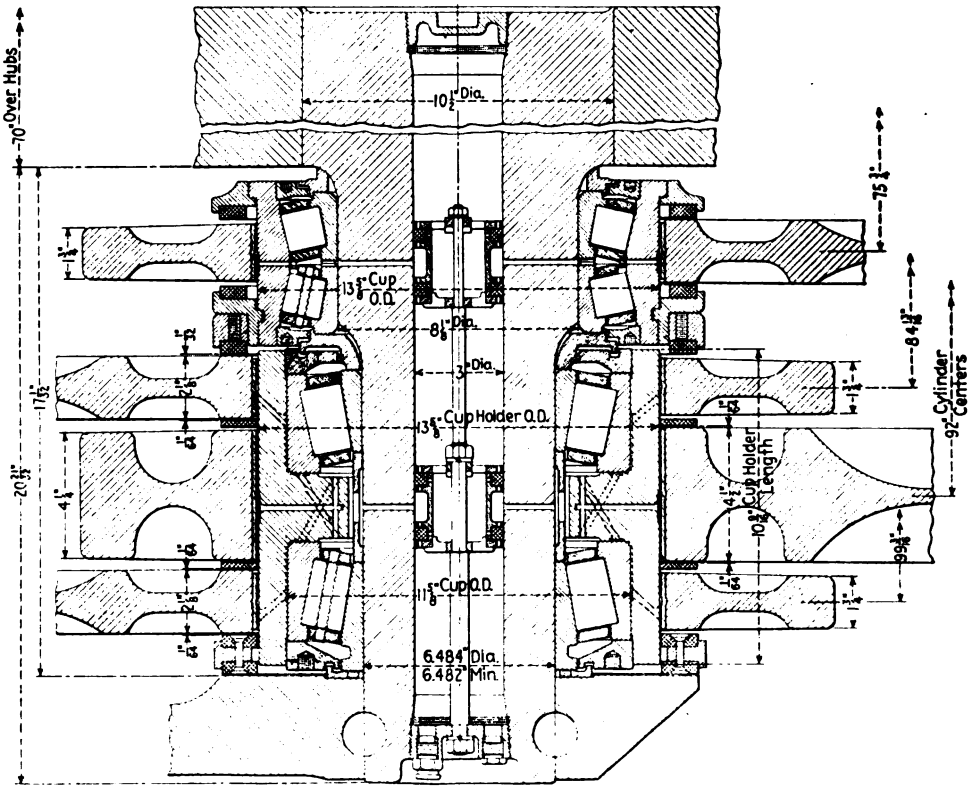
and stoker engine. In addition 72 points are equipped with fittings for pressure grease lubrication.

The brake equipment of these locomotives is the Westinghouse Schedule ET-8 with two 8½-in. cross compound compressors mounted on frame brackets under the smokebox front.

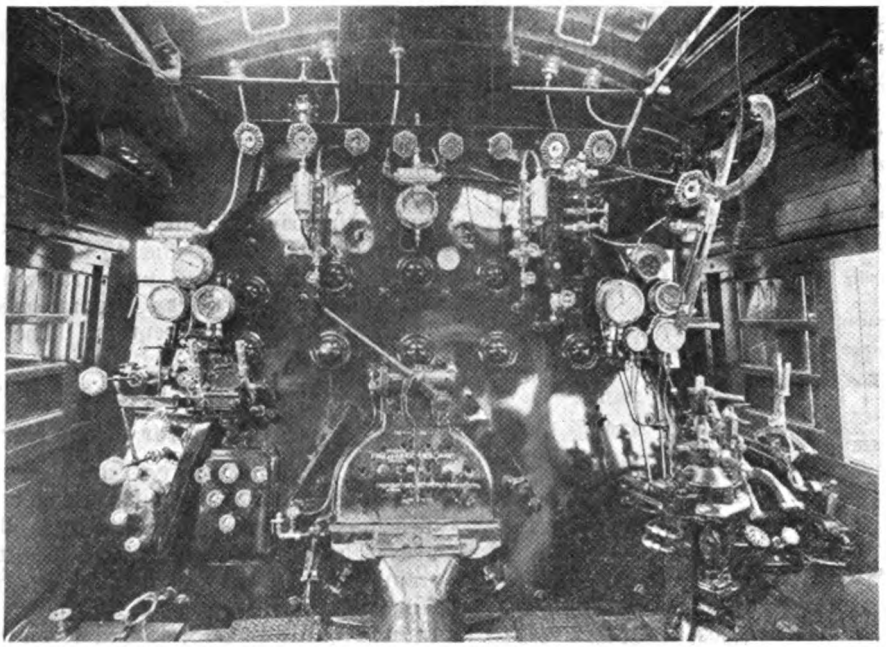
The tenders for these locomotives are of the rectangular type with a riveted tank 42 ft. 7¼ in. long, having a capacity of 20,000 gals. and 35 tons of coal mounted on a water bottom cast-steel underframe and carried on two General Steel Castings Corporation's six-wheel trucks on 27-ft. 6-in. truck centers. The tender trucks are equipped with SKF roller bearings. The tender tank is riveted to the underframe and seal welded.

Character of the Service

The Class J locomotives are used exclusively in passenger service and like all passenger locomotives schedules must of necessity be the controlling factor in their use. These 11 locomotives are used to handle main-line trains Nos. 3 and 4 and Nos. 15 and 16 between Norfolk, Va., and Cincinnati, Ohio, a distance of 676.6 miles and trains Nos. 17 and 18, 45 and 46 and 41 and 42 between Monroe, Va., and Bristol, Va., a distance of 209.8 miles. Shaffers Crossing (Roanoke, Va.) engine terminal is the home terminal for these locomotives and the round trips of 504.6 miles from that point to Norfolk and 848.6 miles to Cincinnati are typical of the runs. The elapsed time of Train No. 3 from Norfolk to Cincinnati is 18 hr. 45 min. and, in the reverse direction, Train No. 4 is also 18 hr. 45 min. This time must be considered in relation to a line of road that crosses the Allegheny and Blue Ridge Mountains with ruling grades, in several districts, of approximately 1.4 per cent. Except between Williamson, Va., and Bluefield, Va., where the ruling grade is 2.00 per cent these locomotives will handle 15 cars without help. The time must also be related to as many as 31 scheduled stops, on some runs, between Cincinnati and Norfolk. With large capacity tenders and complete



Arrangement of the roller bearings for the light weight rods at the main crank pin



lubrication service stops, other than those co-incident with station stops, have almost been eliminated. An accompanying chart shows graphically, a typical week's work for one of the Class J locomotives. The assignment of the entire group of 11 locomotives is shown in Table II.

Table IV—Tabulation of Enginemen's Reports—Shaffer's Crossing Enginehouse

EIGHT CLASS K-2, K-2A LOCOMOTIVES
31 DAYS OPERATION (MONTH OF OCTOBER 1944)

Loco. No.	Days shopped	No. blank reports	No. with work reported	Total	Per cent with work reported to total
117	1	2	23	25	92.0
124	14	3	7	10	70.0
125	1	2	16	18	88.9
127	6	1	17	18	94.4
128	1	1	17	18	94.4
129	1	4	13	17	76.5
130	5	3	9	12	75.0
132	2	4	13	17	76.5
Total	31	20	115	135	85.2

SIX CLASS J LOCOMOTIVES
30 DAYS OPERATION (MONTH OF APRIL 1944)

Loco. No.	Days shopped	No. blank reports	No. with work reported	Total	Per cent with work reported to total
605	1	108	14	122	11.5
606	0	106	16	122	13.1
607	1	106	19	125	15.2
608	1	100	14	114	12.3
609	0	91	16	107	15.0
610	1	107	18	125	14.4
Total	4	618	97	715	13.6

SIX CLASS J LOCOMOTIVES
26 DAYS OPERATION (OCTOBER 9 TO NOVEMBER 3, 1944)

Loco. No.	Days shopped	No. blank reports	No. with work reported	Total	Per cent with work reported to total
605	0	85	13*	98	13.3
606	0	78	17	95	17.9
607	0	90	17	107	15.9
608	10	55	8	63	12.7
609	10	38	15	53	28.3
610	0	88	14	102	13.7
Total	20	434	84	518	16.2

* See list of items covered by these reports.

ITEMS REPORTED ON FORM M.P. 60 FOR LOCOMOTIVE NO. 605 DURING 26 DAYS OPERATION

1 Cotter key out of back end right No. 1 trailer equalizer pin.
2 Trouble with throttle, No. 5 valve stuck. Give guides and cylinders more oil.
3 Grind drain valve to water column.
4 Repair foot warmer, both sides.
5 Steam leak at overflow to injector.
6 Fix bell so it will operate.
7 Pack joint to blow-off pipe.
8 Brake valve dry and won't release with automatic brake valve.
9 Clean out sand pipes.
10 Renew right No. 4 driving brake shoe.
11 Drain valve to left water glass leaking. Bad leak in muffler blow-off cock pipe. Left classification lamp out.
12 Repair leak in pipe to muffler to blow-off cock.
13 Flat spots on drivers.

Mechanical Performance

As mentioned elsewhere in this article the Class J locomotives represent not only an evolution in design embodying the service-tried features of the Class A power but they also represent a definite effort to develop a steam locomotive that will (1) give the maximum in reliability of service; (2) require a minimum of servicing and repair at terminals; (3) operate 250,000 miles, or more, between shoppings for general repairs and, above all, a locomotive that will (4) give this service at a repair cost lower than other locomotive types—either older types of steam power or types using fuel other than coal.

Two tables, III and IV, are included which indicate the manner in which the Class J locomotives have met their expected performance. Table III tells the story of mechanical parts performance and is self explanatory.

Table IV is a tabulation of enginemen's reports (N. & W. Form M. P. 60) for eight Class K-2 and K-2a passenger locomotives and six Class J locomotives. The table shows a comparison of approximately one month's operation of the Class J, and the Class K locomotives which handled the main-line trains before the advent of the J's. Included in the table is a list of the actual work required on one locomotive, No. 605, during 26 days of service. These statistics tell a typical story of the relative value of old and new motive power. The Class K-2 and K-2a are Mountain type (4-8-2) locomotives originally built in 1919 and 1923. They have 28-in. by 30-in. cylinders, 220-lb. boiler pressure, 69-in. drivers, 63,800 lb. tractive force and weigh 248,150 lb. on drivers. The Class K locomotives have modern specialties but are not equipped with roller bearing journals. Mechanical lubrication on the Class K locomotives is used on 11 points on the engine and tender. Their tenders have a coal capacity of 26 tons and 18,000 gallons of water.

The Class K locomotives average only about 250 miles per day as compared with almost twice that for the Class J and the repair cost (Table I) is 15.69 cents per locomotive-mile as compared with 11.54 for the J's.

Air Conditioning for Passenger Cars

THE following two papers were presented before the March 15, 1945, meeting of the Southern and Southwestern Railway Club in Atlanta, Ga. Only that portion of J. P. Morris' paper relating to temperature control is printed here. He also described the method of heat distribution which could be looked for in new and rebuilt cars and the required parts and fittings used in its installation. H. W. Keyser's paper is complete.—EDITOR.

Problems and Answers in Passenger-Car Air-Conditioning

By H. W. Keyser

The Safety Car Heating & Lighting Co., Inc., New York

There has been considerable controversy among several of the railroads regarding the origin of railway-car air-conditioning, however records indicate that the Baltimore & Ohio installed equipment on one coach in 1929. This was a compressor-type using ammonia gas to cool a calcium chloride brine. The power to drive the compressor was obtained from a 30 kw. single phase 220-volt steam-turbine generator on the locomotive. In 1930 both the Atchison, Topeka & Santa Fe and B. & O. equipped one dining car. In 1931 the Missouri-Kansas-Texas equipped three diners. On May 24, 1931, the B. & O. inaugurated the Columbian, consisting of two completely air-conditioned seven-car trains making a round trip each day between Jersey City and Washington. This was also compressor-type equipment using ammonia gas and was driven by 25-hp. gasoline engines. The compressors and condenser fans were belted to a jack shaft which was driven by the engine through a centrifugal clutch. When the engine speed reached a certain value, the clutch engaged the jack shaft driving the compressor and fan.

At the close of the 1932 cooling season, 357 passenger cars of various types were equipped with air-conditioning. In the following 10 years 13,000 additional cars were equipped, giving a total of approximately 13,300 air-conditioned railroad and Pullman cars operating in this country before Government restrictions prohibited the manufacture of equipment.

Now that air-conditioning is no longer in its infancy let us look back and review some of the early difficulties that had to be solved. Like all equipment designed for railroad service, a great many problems confronted the manufacturers of air-conditioning equipment. It was necessary to design the units so that they could be accommodated in the smallest possible space, thereby requiring a minimum number of changes in existing equipment.

Weight was also a matter of great importance to railroads. Not only does it involve increased costs in operation due to hauling heavy equipment, but it may require larger axles, heavier springs and new trucks. Capacity is a requirement substantially fixed by passenger load and outside conditions. The load of seven tons was based on a passenger load of 2.5 tons, solar radiation 1 ton, fresh air 2.1 tons, conduction through car structure 1.4 tons. Power was another definite requirement governed somewhat by capacity. The engineers, however, endeavored to develop efficient equipment to keep the power demand at a minimum. Accessibility for servicing and inspection was another prime requisite. Dependable performance was the result of proper consideration of all factors in design.

More Comfort in New Cars

The various carbuilders have orders for approximately 1,200 new passenger cars and it is estimated that after the war two to three thousand new cars will be built each year for a period of five years. Most of these new passenger cars will reflect the progress that has been made in the design and installation of cooling equipment as well as the further development of innovations made possible by air-conditioning. Sealed double windows insulating against outside temperature, dust and noise, will insure the traveling public a quiet and clean trip. Many other refinements related to air-conditioning have been developed to increase the comforts of passengers. Electrostatic filters are on the market which will remove dust particles as small as 1/250,000 of an inch. This ingenious device charges the dust particles as they pass through an electrostatic field and these charged particles are attracted to plates which are of the opposite polarity and are thereby removed from the air stream. Some use also has been made of filters containing activated carbon for reducing odors. Temperature and humidity controls are available which will maintain comfortable conditions for passengers and eliminate the responsibility of train attendants to adjust the car temperatures as weather conditions vary. Variable-speed motor-driven compressors, or compressors with unloading devices, used in conjunction with divided evaporators can be a valuable asset in maintaining constant temperature and humidity.

The cooling equipment itself has been greatly improved by utilizing durable materials for longer life. Slight changes in design permit greater accessibility and improved maintenance. It is doubtful if any radical changes

will be made from the three most common systems; that is, the ice activated, mechanical, and steam ejector. For the benefit of those not acquainted with these systems, I shall explain briefly the principles of operation of each.

Air conditioning is defined as the simultaneous control of temperature, humidity, movement and purity of air. In reducing the temperature, it is of course necessary to use some means of refrigeration. Refrigeration is a cooling process, or the transfer of heat from one substance to another, and cooling a car is primarily the transfer of heat from inside the car to the outside air. Most systems utilize a cooling coil or evaporator over which air is blown by a fan. This air is cooled on contact with the coil and is distributed throughout the car.

In the ice activated system water is cooled by contact with ice in the ice bunker and is circulated by a pump through a cooling coil. This water absorbs heat from the air passing over the coil and returns to the ice bunkers, where it is sprayed over the ice and loses the heat that was absorbed in the coil.

Refrigeration is obtained in the mechanical system by evaporating a liquid that has a relatively low boiling point. Freon is the refrigerant universally used in railway service. The system is composed of a compressor, condenser, and evaporator or cooling coil. The compressor may be driven by motor, gas engine, or direct from the car axle. The Freon refrigerant in a liquid state flows through the expansion valve into the evaporator. The pressure in the evaporator is comparatively low and some of the refrigerant evaporates, lowering its temperature. The low temperature refrigerant flows through the coils and absorbs heat from the air circulated over the evaporator, vaporizes, and becomes a gas. This gas or vapor enters the suction side of the compressor and is compressed. This increases its pressure and temperature and discharges it into the condenser, where it is cooled and condensed into a liquid. At this point, the heat from inside the car plus heat of compression is transferred to the outside air. The liquid refrigerant from the condenser flows into the liquid receiver and then to the expansion valve for another cycle. Several refinements, which increase the efficiency of the system, may be added to the cycle as some manufacturers recommend sub-coolers, and heat interchangers to reduce the temperature of the liquid refrigerant before it enters the expansion valve.

The steam-ejector system, like the ice activated, uses an inexpensive and easily obtained refrigerant—water.

At ordinary temperatures and pressures water is a liquid, but we know it can be changed to a vapor by increasing its temperature. At sea level, water under atmospheric pressure boils at 212 deg. F.; if, however, the atmospheric pressure is reduced, it boils at lower temperature and its boiling point drops rapidly as the pressure on its surface is reduced. At 29.54 inches of vacuum, water boils at 50 deg. F. The steam ejector system uses this physical characteristic in producing refrigeration. Water in a closed system, under vacuum, is sprayed in a tank—(the evaporator)—where it partially evaporates, cooling itself by this process to the temperature of a very satisfactory cooling medium. The water thus cooled circulates through the coils over which the car air is moved by the blower fan. The heat to be removed from the car has been transferred to the water which returns to the evaporator where it is again cooled.

The vapors formed in the evaporator are removed by a jet of steam pulling on the evaporator. This jet entrains the vapors including the heat from the car. This mixture of steam and vapor pass through the diffuser and enter the condenser, where they are condensed. This condensate is removed from the condenser by a water operated purge, the same water later being used to spray over the condenser. Air is also blown over the condenser making it an evaporative condenser, and finally transferring the heat from the air inside the car to the air outside.

Choice of Air-Conditioning System

All systems, of course, have certain advantages. The advantage of the ice activated system is the low initial investment, small amount of power required, and dependable operation, as a block of ice never gets out of order, but frequent icing is necessary. The advantage of steam ejector equipment is the relationship of power required to the power available. The electro-mechanical system has the advantage of flexibility, as cooling can be obtained without an external source of power, as the power can be obtained from the batteries, which are charged, while running, by a generator.

All systems have disadvantages under certain operating conditions and these operating difficulties often can be avoided, or overcome, by selecting the system most suited for conditions encountered.

There can be no doubt that the air-conditioning of passenger cars has surpassed any other feature developed for the comfort of passengers and has made it possible for trains to be of more than a means of getting somewhere. Cooling will be demanded by the traveling public, in fact it will be taken for granted, as having heating and lighting in the past.

Temperature Control on Passenger Cars

By J. E. Morris

Vapor Car Heating Co., Inc., Chicago

Inside the car itself we must provide temperature comfort for every passenger. In doing this we must recognize the different zones that there are which are affected by varying conditions. The basic zoning of the car, of course, takes into consideration that the sunny side of the car receives heat from the sun itself and normally has about 8 deg. of heat from that source more than the shady side of the car. To offset this the two sides of the car should be under the control of separate thermostats so that whichever side of the car is receiving the sun heat will not add more than a required amount of car heat to bring it up to a comfortable temperature.

Another zone in the car which influences passenger comfort is the end of the car opposite the recirculated grille because at this end of the car the cold air from door openings is pulled into the car and on to the passengers in the first seats. We recommend that this cold effect from the end doors be compensated by applying a

separate thermostat zone at that point. Another condition which should be taken into consideration is the comfort of passengers in the lounge or smoking rooms that are provided. These rooms are entirely separate spaces that are affected by conditions different than those in the body of the car and each should be considered as a separate thermostatic zone.

Five Thermostats Per Car

This means that an ordinary coach with a lounge room at each end would have two thermostats in the body of the car, one on each side, a third thermostat in the non-recirculated hallway and a separate thermostat in each of the lounge rooms, a total of five thermostats. The thermostats themselves consist of a mercury tube construction designed as an accurate thermometer. They have a platinum insert in the glass wall of the tube so arranged that when the temperature brings the mercury to make contact with the platinum wire a circuit is established to operate the relay, controlling valves or other equipment as required to maintain the desired temperature.

A unique feature of this tube comes through the addition of a secondary artificial heat-actuated bulb. This enables a single tube to operate at any desired temperature below its setting in accordance with the amount of artificial heat applied to this secondary insulated bulb. For instance, a tube made to contact at 80 deg. temperature of the surrounding air would operate as a 75 deg. tube if 5 deg. artificial heat were added to the secondary bulb. This also enables us to use the artificial heat as an anticipatory agent to prevent over-runs of temperature.

In addition to this, the overhead heat should be tied into the floor heating of the car and, in thinking of overhead heat, we think first of the overhead heat radiator. It should be designed so that it delivers approximately 20 to 25 per cent of the total heat load of the car. Its basic purpose is to temper the incoming air, and experience has indicated that it should be under the control of a thermostat that is set 1 deg. or 3 deg. below the floor heat thermostat so that the overhead heater delivers air into the car a little cooler than the rising floor heat. The radiator itself should be of the venturi design because its construction permits an even face temperature of the entire radiator under all conditions whether a minimum amount of heat is being taken from the radiator in mild weather or a maximum is being taken in cold weather. The venturi principle insures an absolutely even and instantaneous temperature over the entire face of the radiator under all cycles of heating valve operation.

The thermostat for the overhead heat radiator should be in the new automatic ventilation position. This means that this thermostat should be located in the path of the recirculated air towards the recirculated end about 5 ft. 6 in. from the floor. A thermostat in this location acts to control the heating temperature in the upper strata of the car. Latest applications have been designed so that the overhead thermostat is connected into the floor heat thermostat circuits so that when the overhead heat thermostat is satisfied it automatically cuts the floor heat thermostat temperature setting down approximately 4 deg. The purpose of this is to insure against floor heat building up in the car when the upper strata of the car is at a desired temperature. This is particularly important during loading and unloading of cars when end doors are open in mild weather.

To simplify the operation, inspection and maintenance of electrical circuits in the car, the postwar thermostats have been developed as complete plug-in assemblies, including the mercury tube, relay, resistors, etc., in an easily removable unit.

The thought behind this is that this will permit correction of any difficulties with an individual thermostatic circuit by merely pulling the complete thermo-relay unit from its socket and replacing it with one which has been checked on a test board. This follows through the unit-part idea. It means that the electrician handling the work on the car does not have to be a master on reading circuit diagrams because he can replace the complete electrical assembly with one which is in good condition wherever any inspection or maintenance attention is required. It leaves the panel as a simple unit with only one or two relays on it in addition to the master switch.

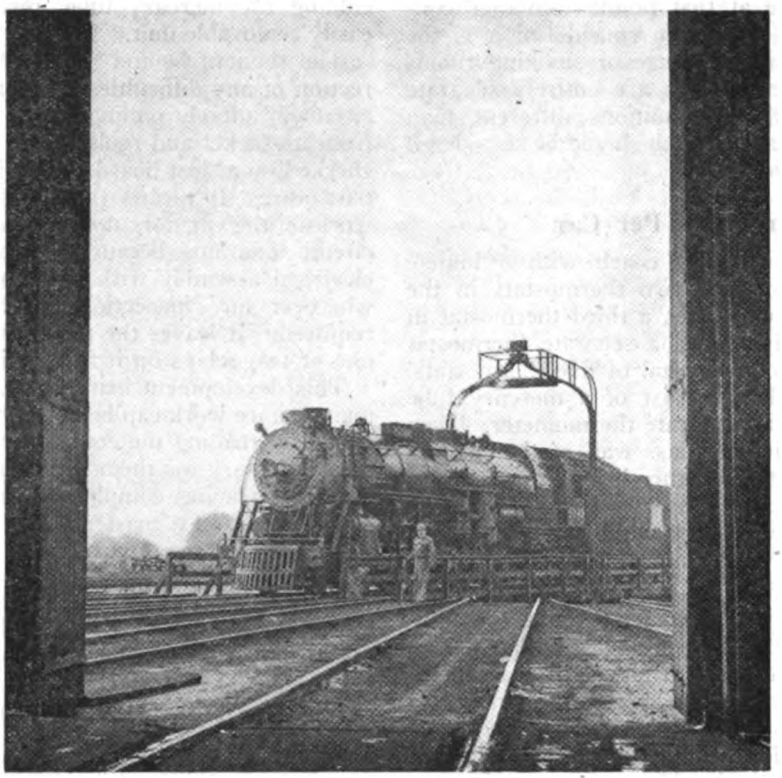
This development brings about the fact that electrical maintenance work can be done without having to use men skilled in reading the complicated circuit diagram. It is only necessary for them to perform the mechanical function of replacing complete assemblies and the checking can be done on a master board in the electrical shop of any units that are removed.

The Control Panel

The description up to this point has covered the heating of the passenger car. Of course, the control itself is for the complete air conditioning. The control panel is designed so that it will change from heating into ventilation and on into cooling and back again automatically. The postwar control panel has on it a single switch that energizes the complete air conditioning equipment, both heating and cooling. There is an external thermostat in the duct influenced by outside air which increases the temperature setting of the heating thermostat approximately 4 deg. when the outside temperature drops below 15 deg. above zero. This same thermostat has another contact in it that increases the cooling thermostat setting by approximately 4 deg. when the outside temperature rises above 80 deg. In some cases we provide a selection switch on the panel with a normal position and designed to move towards a position marked "cooler" on one side of normal and "warmer" on the other side of normal, and this switch is designed to change temperature settings on all thermostats inside the car approximately 2 deg. from normal—this is to permit brakemen the privilege of selecting a variation from the basic temperature air required.

In addition to the heating and air conditioning controls of the car, there is the demand on the part of some of the railroads that humidity be taken into consideration. This can be done in either one of two ways—one is designated as our Sensible Heat Control and it consists of an additional bulb on the cooling thermostat that acts as a wet bulb. A combination of the effect of this wet bulb and the air activated dry bulb on the same tube gives an average temperature that is a combination of both wet and dry bulb temperature in the car and is known as a sensible heat temperature control. It is a very simple and practical arrangement and has been thoroughly proven in tests.

The other method of controlling humidity is by reheat and this is also accomplished simply by a change in the control panel itself which operates in conjunction with a split evaporator used with a mechanical type of air conditioning or with a dual cooling bulb control of a single evaporator for a steam jet or other type of air conditioning. This works along the lines of throwing in the overhead heat when the high temperature cooling tube is satisfied. Its result is to prevent the shutting off of the compressor in mild weather. It also provides a very effective control of the humidity within the car.



Modernized 4000-Class locomotive at the Des Moines enginehouse

Rock Island

Steam Locomotives Modernized

Roller bearings and other improvements in 100 locomotives step up performance and cut the repair costs

THE Chicago, Rock Island & Pacific is now capitalizing on a constructive locomotive improvements program whereby 100 modernized roller-bearing locomotives, supplemented by ten new locomotives, also equipped with roller bearings, are proving a vital factor in handling record-breaking passenger and freight traffic. This new and rebuilt steam power includes: ten heavy modern Class R-67 locomotives, Nos. 5100 to 5109, inclusive, received from the American Locomotive Company in 1944; 64 Class R-67-B locomotives, Nos. 5001 to 5064, inclusive, purchased in 1929 and subsequently thoroughly rebuilt and modernized at the railroad company's shops; 18 Class M-50-A locomotives, Nos. 4044 to 4061, inclusive, similarly rebuilt; 18 Class K-67-B locomotives, Nos. 2689 to 2713, not inclusive, also rebuilt and modernized. All of these locomotives, constructed originally by the same builder, are now equipped with Timken roller bearings and other modern improvements. The first two classes mentioned are of the 4-8-4 type, the third being a 4-8-2 and the fourth, or last, a 2-8-2.

This modern steam power has demonstrated its ability to keep trains rolling and also permitted attaining a number of highly-desirable operating objectives. The monthly mileage of certain classes of locomotives increased to 12,000 and some individual locomotives exceeded 17,000 miles. Annual mileages increased to 100,000 and 150,000. Overall repair costs decreased about 6½ cents a mile. In general, the average tire life between turnings doubled and rod bushing life increased, in some instances, as much as ten times, largely owing to the more accurate and permanent fixing of driving wheel centers through the application of roller bearings.

New 5100-Class Locomotives

The ten 5100-Class locomotives are all oil burners, with a fuel capacity of 5,500 gal., and a water capacity of 21,500 gal. Each locomotive and tender, coupled, has an over-all length of 108 ft. 10 in., and a total wheelbase of 95 ft. 11 in., other dimensions and weights being as shown in a descriptive article published in the *Railway Mechanical Engineer*, September, 1944. Roller bearings are used throughout on engine truck, driver, trailer and tender journals, and Multi-roll bearings are applied on the valve-motion pins. Other features include lightweight piston and lip-type packing, multiple-bearing crossheads with single guides, steam operated cylinder cocks and mechani-

cal lubrication throughout. To minimize rail and equipment shocks in high-speed operation, special attention was paid to counterbalancing all driving wheels and cross counterbalancing the main wheels.

These locomotives are used over extended distances, such as the 520-mile run between Kansas City and Dalhart, Tex. In the month of January, 1945, a typical 31-day month, the minimum mileage made by one of these locomotives was 8,141; two locomotives made over 10,000 miles; one, 16,714 miles; and one 17,261 miles. Up to January 31, one had accumulated a total of 85,077 miles in five months. The average cost of maintenance of all 10 locomotives since installation was 8.8 cents a mile.

Mileage Between Tire Turnings—Rock Island 5000-Class Roller-Bearing Locomotives

No.	New tires applied	Class of repairs	Date turned	Class of repairs	Mileage
5001	Feb., 1942	3-F	Apr., 1943	5	107,500
5003	Oct., 1942	3-F	Dec., 1943	5	90,500
5006	May, 1942	3-F	Aug., 1943	5	104,800
5007	Jan., 1942	3-F	May, 1943	5	117,000
5009	Dec., 1942	5	Mar., 1944	5	100,150
5010	Sept., 1941	3-F	Jan., 1943	5	122,000
5012	Feb., 1943	5	Aug., 1944	5	139,500
5013	Nov., 1941	3-F	Mar., 1943	5	119,400
5014	June, 1941	5	July, 1942	3-F	79,000
5041	Aug., 1942	5	Nov., 1943	3-F	100,800
5042	Sept., 1942	5	Nov. 1943	3-F	98,000
5043	Dec., 1942	3-F	Feb., 1944	5	100,000
5045	Dec., 1942	5	Feb., 1944	3-F	87,200
5049	July, 1943	3-F	Oct., 1944	5	90,400
5053	Jan., 1943	3-F	July, 1944	5	109,000
5054	July, 1942	5	Oct., 1943	3-F	90,100
Average miles made by 16 locomotives					103,450
Average miles before modernization					50,000

5000-Class Locomotive Improved

The Rock Island purchased the first 25 5000-Class locomotives in 1929*. These locomotives proved unusually successful in handling tonnage trains at high speed and 40 more were delivered in 1930. After a survey by the mechanical and operating departments, it was decided to equip these locomotives with roller bearings on all driving wheel journals and to make certain other changes and improvements which would better adapt this power to meet the requirements of modern high-speed service.

Twenty-five of these locomotives were originally built with bar frames and 40 with one-piece cast steel beds. The driving wheel diameter was increased from 70 in. to 74 in. to facilitate higher operating speeds and, with no change in cylinder size or boiler pressure, a decrease in tractive force was anticipated. Experience indicated, however, that the starting tractive force remained about the same owing to reduced friction of the roller bearings and an increased factor of adhesion.

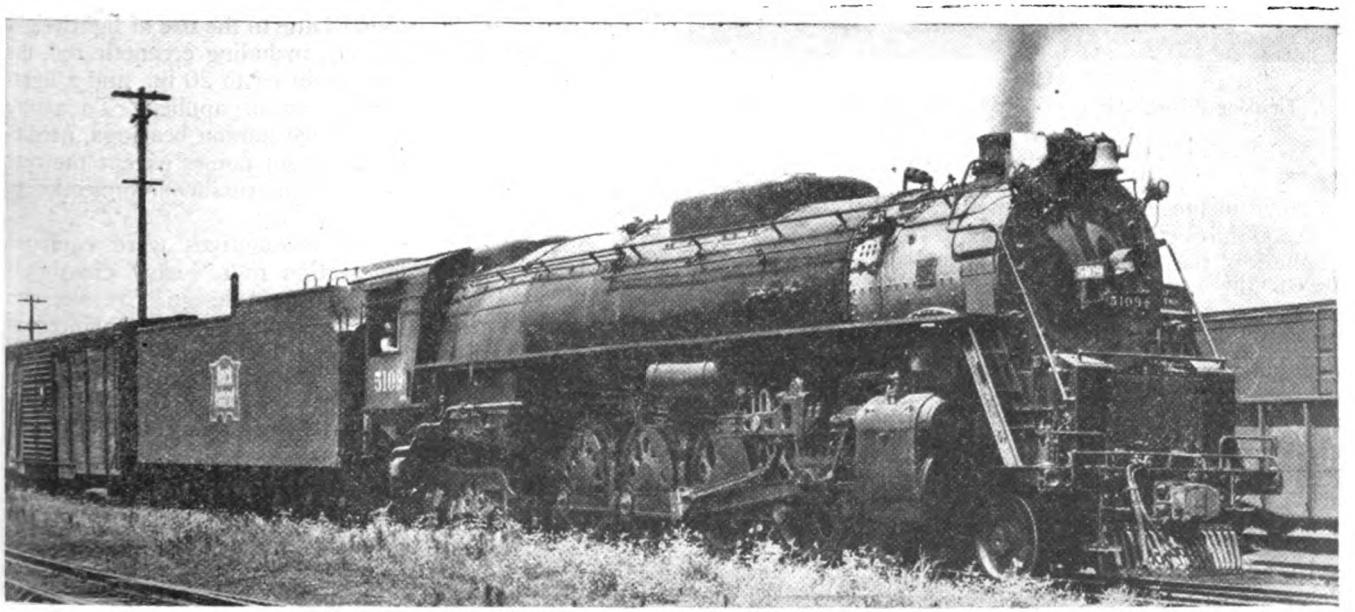
Lightweight main rods and pistons, in conjunction with conventional crossheads, were applied to some of the locomotives and the remainder are now being equipped. The Baker valve gears were equipped with needle bearings at all major points and the valve events modernized. Force feed chassis lubrication was supplied to all driver pedestal ways, feedwater pump, air compressors and guides in addition to the cylninders and valve chambers. The stack diameter was increased from 19 in. to 24 in. and the exhaust nozzle diameter increased accordingly.

To facilitate longer runs, the tender capacity was increased from 15,000 to 20,000 gal. of water on all locomotives of this class, the rear portion of the tender being increased in height to make a larger tank. No change was made in the tender coal capacity of 20 tons, but, on 22 of the locomotives, equipped to burn oil, the fuel oil tank on the tender was increased in size from 4,100 to 5,000 gals. The original six-wheel trucks had sufficient reserve capacity to carry the extra load and no change was made except to install larger wheels 36-in. in diameter.

The best monthly mileage secured with 12 of these locomotives on the Oklahoma division in January ranged from 4,600 to 8,680 miles. The average cost of repairs since the last general shopping was 22 cents a mile and

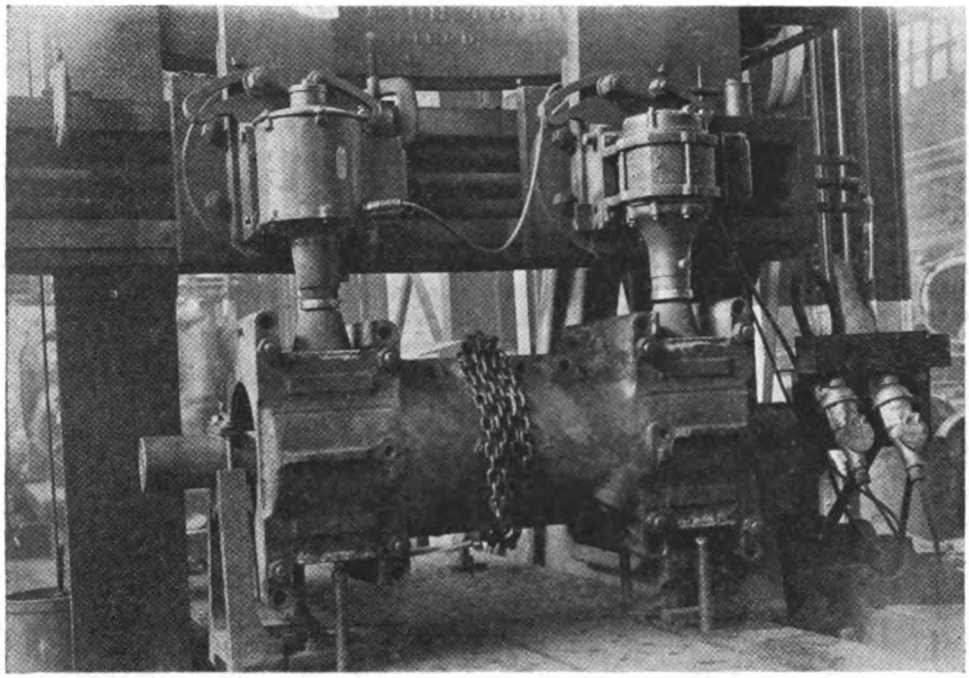
Mileage Between Tire Turnings—Rock Island 4000-Class Roller-Bearing Locomotives

No.	Date turned	Class of repairs	Date turned	Class of repairs	Mileage
4048	Dec., 1942	5	Dec., 1943	5	135,800
4049	Jan., 1944	5	Dec., 1944	5	123,400
4050	May, 1943	3-F	Aug., 1944	5	175,000
4051	Aug., 1943	3-F	May, 1944	5	110,000
4057	July, 1943	A-3	May, 1944	5	111,000
4058	Mar., 1943	3-F	Feb., 1944	5	122,000
4060	Nov., 1942	3-F	Oct., 1943	5	126,200
4061	May, 1942	5	Nov., 1943	5	165,900
Average miles made by 8 locomotives					133,660
Average before being modernized					75,000

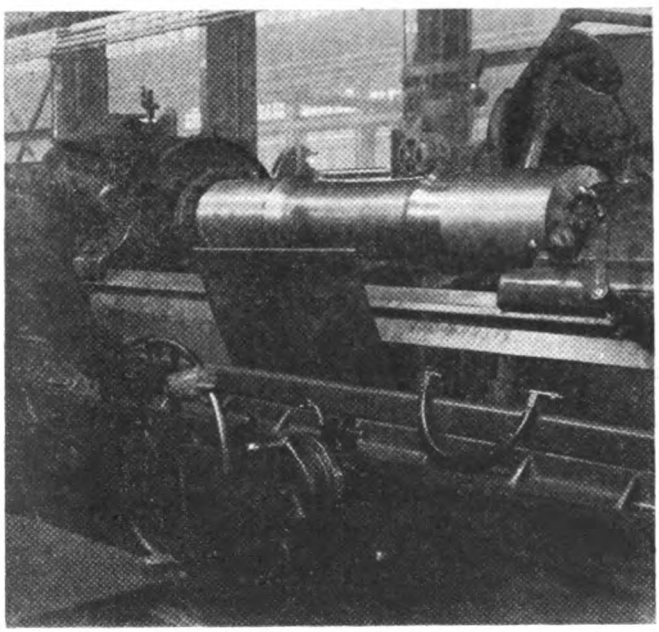


One of the new 5100 Class locomotives ready to go

* See the December, 1929, *Railway Mechanical Engineer*, page 717.



Housing support and double grinders used in truing worn pedestal ways



Finishing driving axle on a Cincinnati grinder at Silvin shops

in some instances these locomotives had made well over 200,000 miles since the last general repairs early in 1942. A check of the tire mileage on these locomotives indicates that before conversion they made from 45,000 to 50,000 miles between tire turnings. The provision of accurately fitted roller bearings and driving boxes tended to eliminate quarter slip and reduce wheel sliding with attendant substantial increase in tire life. The average mileage between tire turnings on 16 of these locomotives after conversion was 103,450 miles, as shown in one of the tables. Rod bushing life also was definitely increased.

Work Done on the 4000-Class

In addition to other mechanical improvements, the dome seams of 4000-Class locomotive boilers were reinforced, where necessary, in order to permit increasing the steam pressure from 200 to 220 lb. cylinders were bushed from 28 in. to 26 in. and a current program calls for the application of new cast steel front bed sections. Roller bearings are applied to all drivers, engine trucks and trailer wheel, also within recent months to all tender truck wheels.

Lightweight main and side rods were applied, also Timken hollow piston-rods and Timken-type crossheads with aluminum shoes and block-tin faces. Since steam passages in the original cylinders produced an improved area ratio to the new reduced cylinder size, the valve events were changed to give larger areas through the bushing ports and improved efficiency for steam use at short running cutoffs. The new dimensions are as follows: lap, 1½ in.; lead, 7/32 in.; exhaust clearance, ⅛ in.; maximum valve travel, 8½ in.; steam port width, 2⅛ in. The maximum starting cutoff was reduced from that on the original locomotives but was kept within limits to maintain good starting characteristics.

In conjunction with the higher operating speeds made possible through changes in the valve events, and the reductions in dynamic forces due to the use of lightweight reciprocating parts and rods, including eccentric rod, the eccentric throw circle was reduced to 20 in., and a lightweight design of eccentric crank applied. To assure against lost motion in the valve motion bearings, needle-type bearings were applied at all points except the rear end of the eccentric rod and the crosshead connection to the union link.

The original 4000-Class locomotives were equipped with heavy rectangular section rods, heavy crossheads with solid piston rods and a heavy design of piston with separate bull rings. The locomotives were balanced in the conventional manner, along the lines of 1915 A. A. R. recommendations and the static overbalances at the various positions were as follows: No. 1 driver, 193 lb.; main, 485 lb.; intermediate, 325 lb.; No. 4 driver, 168 lb.

When the main wheels were replaced, without changes to the running gear of the locomotive, a wheel design incorporatoing a crossbalance along the lines of the A. A. R. recommendation at that time was applied, the balance block being located at an angle of advance to the center line of the crank arm.

When the locomotives were equipped with lightweight

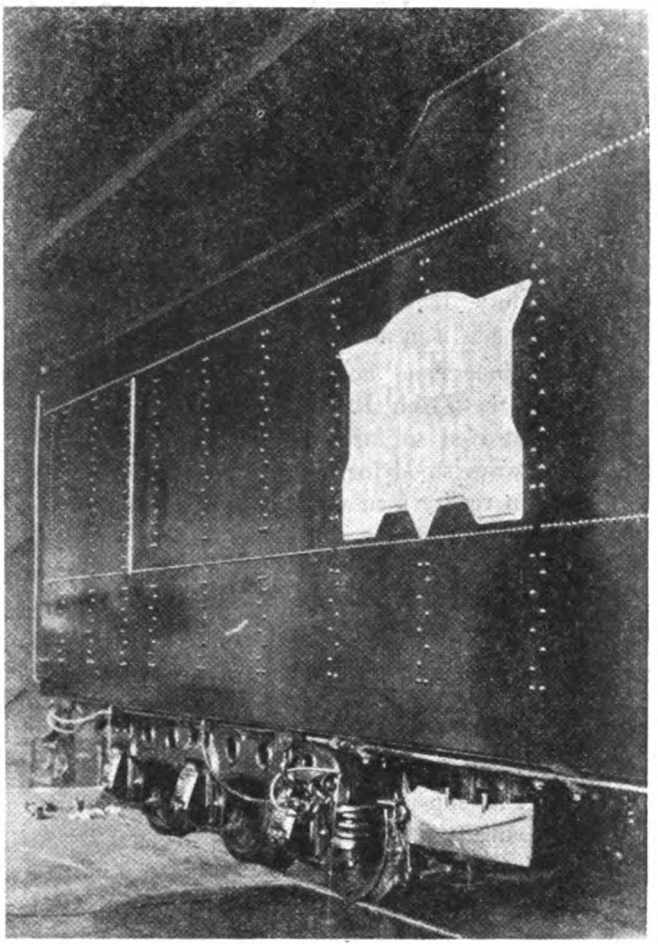
moving parts the locomotives were rebalanced. The main wheels crossbalanced and the other wheels balanced in the conventional manner, except that transverse out-of-plane forces were considered. Weights for the front and back of the main and eccentric rods were determined from the center of percussion. The amount of reciprocating balance in the main wheel was added in prior to final determination of the angle of advance of the counterbalance block.

The wheel counterweights were modified to produce the proper angle of advance and weight by means of tubed holes through the balance pocket. The overbalance provided at the various positions were as follows: No. 1, 138 lb.; main, 165 lb.; intermediate, 180 lb.; No. 4, 141 lb. The dynamic augment of the main wheel was reduced to 7,409 lb. at diameter speed.

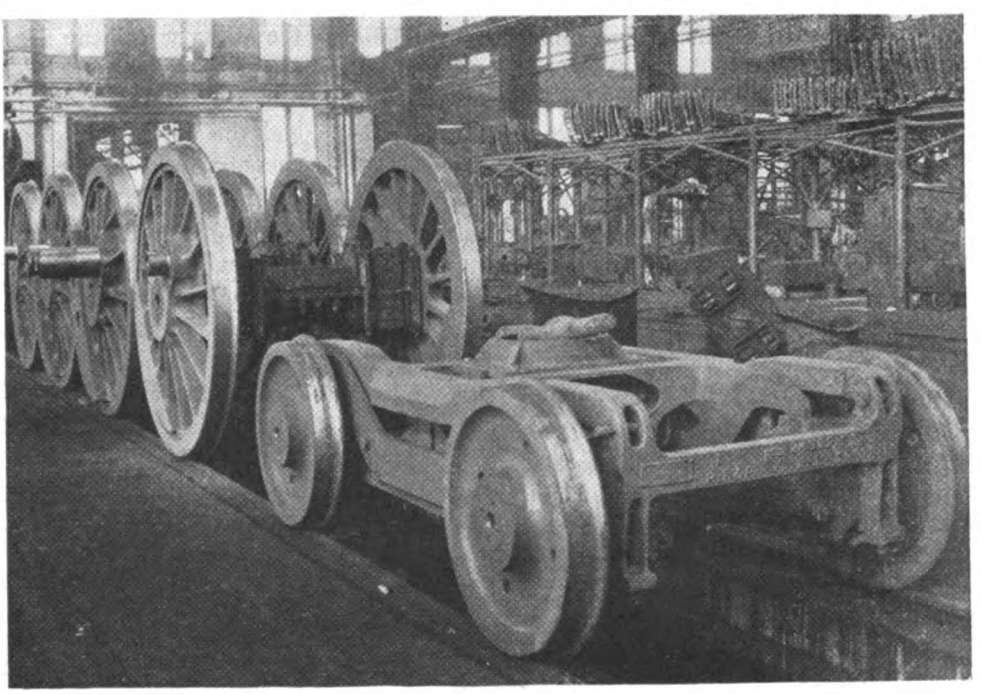
Ten of the original 4000-Class, M-50 locomotives on the Rock Island division made from 7,000 to 8,400 miles a month in January and had an average cost of repairs of 21 cents a mile. Fifteen of these locomotives, converted to the M-50-A class and used on the same division in January, made 11,000 to 15,300 miles during the month and the cost of repairs was only 15.5 cents a mile or 5.5 cents less.

As regards tire mileage, a group of eight representative M-50-A locomotives averaged 133,600 miles between tire turnings, as shown in the second table, which may be compared with 75,000 miles before conversion. The accurately positioned driving wheels in conjunction with carefully quartered and stroked crank pins had the effect of increasing rod-bushing life. Whereas rod bushings sometimes had to be renewed after only 3,000 miles of service, bushings on the converted locomotives frequently ran up to three months or possibly 30,000 miles for the main rods and somewhat longer for the side rods.

A similar pattern of improvement was followed in the case of the K-68-B locomotives which retained the 28-in. by 30-in. cylinders and the boiler unchanged, but had the steam pressure raised slightly from 210 to 215 lb., thus increasing the tractive force from 67,000 to 68,000 lb. Roller bearings were applied to the drivers and eventually will be to the engine truck wheels. The tender capacity was increased from 10,000 to 14,000 gal. of water. There was no change in coal capacity, but on 12 locomotives equipped to burn oil, the fuel oil tanks were increased from 3,600 to 4,550 gal. New four-wheel tender trucks with 6½-in. by 10-in. journals were installed.



The rear of the 5000-Class tender was increased in height



Roller-bearing drivers and engine truck ready for wheeling the locomotives

The 716th – A Good Outfit With A Few Poor Men

A.P.O. 887
24 April 1945

To: The Railroad Men, Their Families and Friends.

American railroad men who are charged with the safe and on-time delivery of millions of tons of freight each year are fundamentally honest and devoted in their attention to duty. It is their job to see that the receiver of the freight gets it in perfect condition and on time.

I cannot understand how, with their background, members of the 716th Railway Operating Battalion could have strayed so far from the principles which they have always stood for, unless, perchance, the accused were in reality men without railroad experience or background, but simply a cross-section of American citizenship drawn into the Army by induction, a proportionate number of which were assigned to the Military Railway Service units. I just cannot feel a group of railroad men had gone wrong to the extent that the reports from the trials and convictions seemed to indicate.

The railroads of America actually crippled themselves to give us experienced officers and a great many experienced enlisted men. In order to have the necessary railroad experience, most of these officers and men really had to be above Army age. Many of them served in the last war. Now with particular reference to the 716th Railway Operating Battalion, this Battalion is composed of 887 officers and enlisted men; only 349 of these were even questioned and 160 brought to trial, of whom almost one-half had had no railroad background. Those with railroad background who were brought to trial represented only three-tenths of one per cent of the total strength of the Military Railway Service in this theater. Of the 22 men tried and acquitted, 17 had railroad background.

One of the men convicted and sentenced to a long term was from my own home town, St. Paul, and reports from St. Paul indicate that this man was not a railroad man and that he had a police record before he went into the Army. I have not had a chance to check up on the previous record of some of the others, but I do know that it was most unfortunate, and, to me, definitely misleading that the 716th Railway Operating Battalion's name seemed to be used each time there was a conviction in connection with these black market operations, even though the man sentenced did not belong to the 716th Railway Operating Battalion.

I have no brief for a thief, but I have lived among railroad men all my life and know them to be fundamentally honest. The thing that I want the American public to understand is that neither this Battalion nor any of the American railroad men in the 67 units, and over 30,000 men, are thieves. They are conscientious rail transportation men who are as much interested in getting the supplies to the soldiers in the front lines, their consumers, safely and on time, as they ever were back on a commercial railroad in the United States, where their bread and butter depended upon a continuation of that kind of service.

I have talked to too many of them and they look upon their responsibilities here and to their Big Shippers—the Services of the Army—and their consumers—the soldiers in the front-line trenches—with a higher degree of service standards than they have on the most competitive commercial railroads back home. In the United States their jobs depended upon successful, safe and on-time rail transportation. Over here, they know that their future, the future of their families, the future of their country, in fact, the future of the world, requires the same dependable rail transportation service for the Armies that they have always given the shipping public of the United States. They have given that unstintingly.

They know no 16-hr. laws over here. An engineer will work on a track if necessary and a conductor will help build bridges, while the "gandy-dancer" will try to run a locomotive if there is no engineer available. They are not thieves and they are not criminals, but they are American citizens with a pride and a love of their industry and their work, a mature realization of their responsibilities, and a devotion to duty that has been superb. They are pushing forward tens of thousands of tons of freight a day to their comrades in arms, the men of the Armies they are supporting, and I just cannot stand idly by and let an impression go unchallenged that they have so completely forgotten their American railroad standards and principles, as well as their American ideals, as to be guilty in other than a very small degree of the whole black-market operation, which fortunately have been nipped in the bud in time.

To the everlasting credit of the 716th Railway Operating Battalion and to the other battalions and units of the Military Railway Service in this theater, all of these men have gone steadily forward in doing their job of railroading for the Armies. Their morale is excellent and the 716th Railway Operating Battalion has just passed a rigid inspection with an excellent rating. The 716th's Bulletin of March 24 states, "The end of March is nearly here and still no venereal disease in the 716th." This indicates to me that they are good solid American railroad men, that they still have confidence and faith in themselves, in their unit, in their railroad industry and in America, and will not permit exaggerated and false accusations about them in any way to lessen their attention and adherence to duty, nor "slow them down" in doing their share of moving the freight forward to the Armies.

With kindest regards.

Sincerely yours,
CARL R. GRAY, JR.,
Brigadier General, USA
Director General

EDITORIALS

Mechanical Labor Conditions Critical

The critical condition of railroads as regards mechanical department labor is indicated by Railroad Retirement Board statistics showing a shortage on Class I roads, as of March 31, of 12,610 skilled trades journeymen and 11,054 skilled trades helpers and apprentices. In addition, there was a shortage of 788 coach cleaners and 7,950 shop laborers. Moreover, it is estimated that half of the mechanical forces now employed are relatively inexperienced and include substantial numbers of over-age men, teen-age boys and considerable numbers of women with no previous railroad experience and consequent limited capacity to perform this class of work.

On one typical large railway system, the manpower shortage on March 31 included 289 mechanics, 60 helpers, 52 apprentices, 79 laborers and 8 coach cleaners or a total of 488 men. This represented only 80 per cent of the shortage on March 31, 1944, but this indicated slight easing in the situation did not extend to all crafts, such as the machinists, boilermakers, etc.

One step taken to meet the shortage has consisted of promoting all apprentices upon completion of their apprenticeship, but a large proportion of those promoted have been inducted into military service and this includes practically all apprentices employed since 1940 who have been inducted on reaching the age of 18 before completion of the two years' training required for promotion.

Another step has been the up-grading of helpers of the various crafts to mechanics-tentative and assigning them to such mechanic's work as they were qualified to perform. There are 462 such men still in service. Many others so promoted have been inducted into the armed forces. At some points, the list of helpers qualified for promotion has been exhausted, while at other points all have been promoted for whom semi-skilled work within their capacity to perform can be provided. While helpers have been employed or up-graded from laborers in considerable numbers since 1940, little further relief through up-grading from this source can be expected.

A total of 800 laborers have also been up-graded, mostly to helpers of the various trades, but some to locomotive firemen, brakemen and yardmen. On this particular railroad, the supply of unskilled and semi-skilled labor has improved in general, except at shops and terminals in or near large industrial cities.

The prospects for the balance of the year point to some slow improvement in unskilled and semi-skilled mechanical labor conditions, which, however, continue to be critical. Even with the close of the European War, there is not much basis for anticipating a marked increase in the supply of skilled mechanics. This problem, which has such a vital bearing on railway operation and the successful handling of the nation's war and civilian traffic, is still definitely before the War Manpower Commission and the local Selective Service Boards.

Safe Loading Of Freight Cars

Cars loaded for movement over American railroads have every likelihood of arriving at their destinations without damage to the ladings if certain minimum requirements for safe loading are followed. In a talk delivered before the Eastern Car Foreman's Association in New York, A. H. Keys, assistant superintendent car department, Baltimore & Ohio, and a member of the Loading Rules Committee of the Mechanical Division, developed this point at some length as he outlined typical situations in which the Loading Rules Committee had functioned. Mr. Keys stressed particularly the limitations upon the value of the work of the Committee which can arise through the failure of shippers or carriers to observe the rules. Although the rules are mandatory, instances have been known in the past where traffic considerations had led carriers to accept shipments not loaded in accordance with the rules. According to the speaker, such cases, when dealt with through the responsible officers of the carriers involved, have not been repeated. It is to be hoped that similar situations will not again arise when competition for traffic resumes under peacetime conditions.

No better argument for compliance with the rules as worked out by this committee could be presented than the wartime performance of the railroads in carrying a record freight traffic. The rules in general have proved adequate, necessary changes have been made promptly as need appeared. Military loadings were specially studied and prepared for before our entrance into the war and the uninterrupted flow of such shipments between army installations in this country and between arsenals and manufacturing points to our ports has earned for this committee the right to feel proud of its foresight in formulating the rules.

In the discussion which followed the presentation of the paper it became more than ever clear that observance of the rules meant safe movement of cars without the necessity for adjustment or transfers of loads. Instances cited from the floor of shifted ladings, etc., when discussed in the light of rule requirements proved to be cases in which the rules were not fully observed even when there was no evidence of intent to skirt or disregard the applicable provision for safe loading.

Other important and interesting things brought out by Mr. Keys were that the committee was ever ready to cooperate in the study of rule changes; that none of the rules are arbitrarily imposed; that, in every instance, the requirements represented minimum securements; and, most important, that the car inspectors throughout the country are, in the final analysis, the key men in the whole loading set-up. Under present conditions their burden is a heavy one but as they remain alert and require close adherence to safe-loading practices, war and other freight will continue to move safely.

Sixty Clear Channels

Release to the railroads of 60 clear radio frequency channels for train communication, as described elsewhere in this issue, means that the railroads will no longer be restricted by temporary experimental assignments and can proceed to develop space radio as well as carrier for this purpose. There are still a few hurdles for the railroads, but none of them insurmountable.

Committee 7 of Panel 13 of the Radio Technical Planning Board must continue to work with the Federal Communications Commission to develop engineering practice and operating procedure, and the railroads will be required to make application to the Commission for authorization to use specific channels and to the War Production Board for priority to purchase equipment.

The assignment of channels is the result of careful and thorough study on the part of the Commission and much credit is due to the work of Committee 7 and specifically to its chairman John L. Niesse for presenting the railroad's case to the Commission. The assignments should be ample to fill railroad needs and it now remains with the railroads to avail themselves of the opportunities afforded by the assignments.

In the proposed allocations issue by the Commission on January 16, 1945, the railroads were assigned 33 clear channels in addition to some others to be shared. At the hearing held in Washington, February 28-March 2, 1945, the railroads offered objections to 60-kc. channels rather than 100-kc. channels, saying that the narrower band would entail difficulties and increase costs. In the final assignment the Commission stuck to the 60-kc. channel width, but increased the number of channels from 33 to 60. Apparently the Commission wishes the railroads to use 60-kc. channel widths, if this can be done practically under railroad operating conditions, but there would appear to be some latitude which might make it possible to appeal for wider channels if the narrow one proves impracticable.

Some technicians believe either AM or FM can be used practically for voice transmission on a 60-kc. channel. Others feel that the use of frequencies around 3,000 mc. should be worked out employing only FM. But whatever the ultimate or the best may be, the present assignments provide an opportunity for installing a railroad aid which in many cases may pay for itself in months. It will be a matter of several years, conceivably six or eight, before sets in the 3,000-mc. range are developed and generally available. The change from 160 to 3,000 mc. would mean the scrapping of sets, but the savings to be made in any such interim period should be such that no one who wishes to use radio for train communication would be warranted in waiting for further development.

Wartime Lessons Will Guide Future Operations

With the shifting of traffic from the eastern seaboard to the west coast we will be imposing a traffic burden of increased proportions upon transportation facilities already loaded to capacity. The next 12 months will probably provide a test whether new operating methods and facilities developed in the 43 months of wartime traffic handling are as good as they appear to be—whether they have the flexibility for further expansion if necessary. Our transport machine has so far met practically everything that has been asked of it and in the process of meeting these demands lessons have been learned which if applied in time assure that the danger of failure during the remainder of the war will be remote insofar as motive power is concerned.

For many months we have been keeping more than 85 per cent of our locomotive inventory on the active list all the time but unfortunately the statistics dealing with the performance of motive power conceal effectively the cornerstone that has really held up the entire motive power structure—the 2,000 or more modern locomotives representing, on individual roads, as little as 30 per cent of the total inventory but operating as much as 50 to 60 per cent of the mileage.

The term "modern locomotive" as applied to steam power has been used rather loosely so that one pauses occasionally to ask what a modern locomotive is. Age alone does not necessarily indicate whether a locomotive is modern or otherwise, for it is conceivable that there are new locomotives built that are not modern. A modern locomotive can be recognized by good design proportions, with a boiler that has just a little more capacity than the maximum job it is called upon to do; one equipped with roller bearings and mechanical lubrication to all important working parts.

If one is in doubt as to the value of these factors, there will be found elsewhere in this issue two articles; one dealing with a group of 4-8-4 locomotives on the Rock Island and another with a group of locomotives of the same wheel arrangement on the Norfolk & Western. The Rock Island locomotives have truly been the backbone of traffic handling on that road for many months and the figures which are shown relating to actual performance data are evidence that locomotives so equipped actually can double the mileage between tire turnings. The Rock Island locomotives averaged 133,600 miles between tire turnings and the N. & W. locomotives, used entirely in passenger service handling heavy trains over mountain grades, averaged 119,000 miles. When one considers the expense of dropping

wheels and turning tires it is not a difficult matter to translate these performances into terms of savings, not only in time but in money. Mechanical men are always interested in costs and beyond mention of the repair costs for these groups of locomotives on the two roads—an average of 21 cents, 15.5 cents and 11.54 cents per locomotive mile—it is hardly necessary to amplify a bit of evidence that indicates the relative value between a modern locomotive and one built 20 years ago.

In addition to the outstanding job done by the new steam locomotives there has been, in many respects, a still more striking job done by the Diesel-electric road locomotives in both passenger and freight service. In 1944 the Diesel-electric road locomotives, in freight service alone, accounted for approximately 20 million freight locomotive miles. When this is compared with the approximately 9 million freight locomotive miles operated in 1943 it can be seen that the Diesel is an influence of rapidly increasing proportions in the freight transportation picture.

The above high spots of performances that are amplified in considerable detail in the two articles referred to are but samples of the results of many developments in motive power during the past few years and during the war particularly the railroads have learned important lessons which place them in possession of operating and mechanical facts invaluable in guiding future policies. The next few years will be critical years when the pressure of competition with other forms of transportation may demand more study and effort than has the handling of war time traffic. Manufacturers have shown the way to the future with a multitude of new ideas, and if the railroads will but remain alert to the exploitation of future developments their ultimate success seems assured.

Use of Treated Car Lumber Increased

A report on the uses of treated wood for car lumber, prepared by a committee of the American Wood-Preservers' Association, as presented elsewhere in this issue, gives a detailed list of more than 5,400,000 ft., board measure, of treated wood used in 1944 by 11 roads. This important modern structural material was employed for the building or repair of freight cars, including creosoted and salt-treated material for decking, nailing sills, coal-car and stock-car sides, running boards, saddle blocks, stringers, furring, stock-car superstructures, ballast-car sides, and floor racks and ice bunkers in refrigerator cars.

The amount of treated lumber utilized was approximately 2,400,000 ft. more than that reported for 1943. In addition, three roads reported an unspecified amount of treated lumber used for the construction or repair of 1,540 cars, and two other roads reported favorably on treated material for certain members.

A program employing pressure-treated wood in the heavy maintenance reconstruction of certain classes of freight cars has just been initiated by the Pennsylvania. Decking, floor supports and running boards have been ordered for 100 box cars and running boards for 25 stock cars, all pressure treated with chromated zinc chloride, as well as creosote-treated roofing and flooring for the stock cars. Chromated zinc-chloride-treated running boards are also being supplied for 500 new box cars for another eastern railroad.

NEW BOOKS

NEW METHODS FOR SHEET METAL WORK. *By W. Cookson, M. Inst. Met., A. M. I. Prod. E. Published by The Technical Press, Ltd., Gloucester Road, Kingston Hill, Surrey, England. 208 pages, 5 in. by 8½ in., illustrated. Price, $3.*

This third edition of New Methods for Sheet Metal work is a practical textbook for apprentices, sheet metal workers, platers and draftsmen engaged in engineering, aircraft, shipbuilding, and other industries. The book modernizes and simplifies geometrical development procedure and puts the practice of laying-out patterns on a more exact basis than hitherto believed possible by using calculation methods to insure dimensional accuracy of the finished product. The chapters which deal with the development of sheet-metal patterns by mathematical formulas, particularly as applied to triangulation problems, are believed to be the first ever published. Examples given are typical of actual jobs.

THE MODERN GAS TURBINE. *By R. Tom Sawyer. Published by Prentiss-Hall, Inc., 70 Fifth avenue, New York. 250 pages, 6 in. by 9 in., 131 illustrations. Price, $4.00.*

The gas turbine has been very much in the limelight during the past three or four years and yet because of the war much of the development work that has been done during that period has either been done without any great amount of publicity or has mainly been the subject of papers before technical societies. The gas turbine, in its several forms, appears to have great possibilities in the future and there is considerable curiosity concerning its principles and applications both on the part of the layman and the engineer in industry. With the idea of satisfying the needs of both these groups the author of this non-technical work has co-ordinated the available data on the subject into a book that is well organized and extremely readable. From the opening chapters dealing with historical background, through chapters which present the fundamentals of principles and design and on into that part dealing with the many practical applications of the gas turbine the author has kept in mind the diversity of interests of the reader to such an extent that irrespective of whether he be in railroad, marine, public utility or aeronautical work his questions will find an answer. Of particular interest to the railroad man is the chapter on the gas-turbine locomotive. In it are discussed the existing applications, both in this country and Europe, of the gas turbine as a supercharger for Diesel engines and as a prime mover.

THE READER'S PAGE

Turbine vs. Reciprocating Engine

To the Editor:

The editorial in the April issue on "How High a Price Can We Afford to Pay?" is appropriate but, possibly, a bit premature. The real economies of a turbine-driven locomotive will not be known until time determines its maintenance cost.

The last paragraph expresses the hope that the designers of boilers will concentrate their efforts on solving boiler problems so that a better conventional locomotive will result. The need for such an improved boiler is paramount, but if the ultimate is attained the steam generated will be too high in temperature to permit its use in a reciprocating locomotive. Beyond current temperatures of 750 deg. F., lubrication of pistons becomes difficult, if not impossible. On the other hand, the turbine can use 900 deg. steam at pressures well over 1,000 lb. per sq. in. with efficiency. The improvement in boilers will probably, if realized, hasten the obsolescence of the reciprocating locomotive.

In power generating stations, pumping stations and other large land power uses the reciprocating steam engine became obsolete with the development of efficient turbines. The efficiency of the modern powerhouse is the result of a series of developments involving all of the equipment in the plant from boiler feed pumps to condenser hot well. The "choo choo" may not share in many of these developments because of restricted height, width and length and because of a certain amount of vibration. Neither can it draw a continuous supply of cooling water from a stream so that steam can be condensed and deturned to the boiler as clean feedwater.

With the elimination of the steam engine in bulk power generation and ship propulsion, there is wonder that it could have continued to exist on locomotives. The history of locomotives is replete with advances that have permitted increases in power and in efficiency, yet all have been accomplished without increasing the track gauge. There must be an eventual limit to the amount of steam that can be generated in a single unit within standard railroad clearances and wheel base limitations, and when that limit is reached the answer to "more power" will be to use more efficiently the steam obtainable from the maximum boiler.

Due credit must be given to the designers and builders of the locomotives which have moved war traffic in almost incredible amounts. Certainly the locomotive builder, along with the railroad, deserves the heartfelt thanks of 130 million people.

The conventional locomotive, thermally, is not an efficient machine. The firebox is limited in area so that fuel burned, in pounds per square foot of grate per hour, is very high. The boiler absorbs as much heat as possible from the hot gases in the few seconds required for these gases to pass into the smokebox, but heat lost out the stack is still excessive. Water used is the best obtainable and is usually treated; nevertheless, every bit of sediment going into the boiler remains there to obstruct heat transfer. The heavy draft carries some of the fuel out of the stack. Poppet valves and variable cut-off have improved engine efficiency but in overall efficiency much is to be desired.

As in the power plant, and on ships, the turbine has now taken its place on a steam locomotive. Who would cite reasons why it cannot be as outstanding in locomotive service as it has been in power plants and on ships? Marine experience has proved that turbines and gears operate at full power for long periods without other attention than lubrication. Many marine geared turbine propulsion units are operating that have not even been opened for inspection for five years. It would be too much to hope that the first geared turbine locomotive built in this country—and one of the largest locomotives of any type ever built—would operate for years without developing at least some minor defects.

The fourth paragraph of the editorial expresses the fear that the use of turbines will increase the first cost of a steam locomotive until it practically equals that of a Diesel, and that a complexity of wearing, high priced parts will wipe out another advantage that such a locomotive might have as compared with a Diesel. On the basis of the actual drawbar horsepower delivered at the rear of the tender there is no reason why the price per drawbar horsepower of the non-condensing steam-turbine locomotive, built in the same quantities as Diesels, should not be materially lower than the Diesel. As for the complexity of parts, a turbine consists of one revolving part, turning in two bearings with a thrust bearing to keep it in proper axial location. The gearing and drive contain a few moving parts that might be expensive to replace, but certainly will not be expensive to maintain.

The gas turbine has more appeal, probably, to the transportation industry, than for any other application. The railroads, however, with much of their motive power thoroughly worn out in war service, cannot wait indefinitely for a gas turbine. The motive power need is current. In the meantime, the steam turbine locomotive may fill the needs of the railroads. It doesn't sound like a locomotive, but it does look and smell like one. And, if other applications can serve as a criterion, it will not only run well but will be economically sound.

M. Kenney

Westinghouse Electric & Manufacturing Co.

With the Car Foremen and Inspectors

Reclamation of Car Repair Material

According to a circular letter issued under date of April 28 by the A.A.R. Mechanical Division, some railroads and private car owners are purchasing from secondhand dealers various items of car-repair material, particularly truck side frames and couplers which have been reclaimed by welding without proper heat treatment and marking as prescribed by Interchange Rule 23, and have applied such material to their own as well as foreign cars.

Investigation by the Mechanical Inspection Department of the Division has developed that side frames and couplers are being reclaimed in certain instances without the heat-treating facilities required for proper handling of the work.

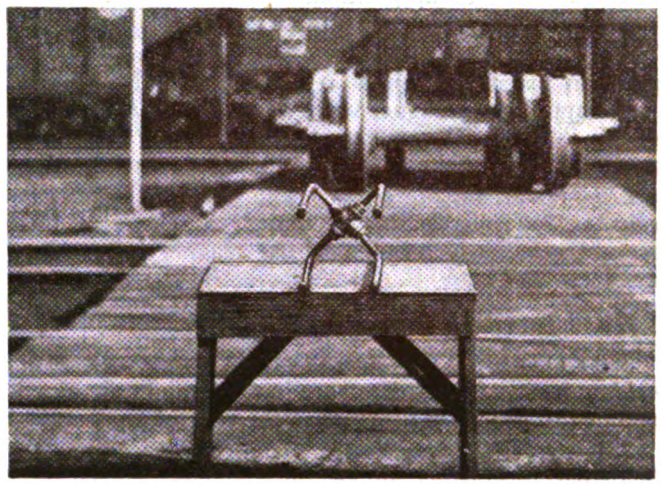
The Mechanical Division emphasizes the obligation of car owners and railroads who desire to purchase such reclaimed material for use on cars operating in interchange service to assure themselves that the dealer has the necessary equipment to perform the reclamation and that the work is being done by the methods outlined in the rule.

Cleaning Car-Wheel Journals

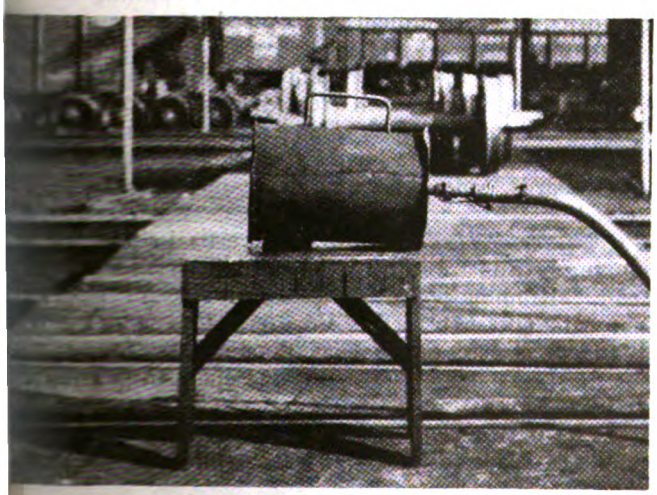
The time required for the removal of the rust-inhibiting agent applied to car-wheel journals has been shortened at the Glenwood car shop of the Baltimore & Ohio. The procedure followed is being made standard for all shops where steam lines are located near wheel tracks.

Instead of using solvents for the removal of the rust-inhibiting coating, this material is now softened sufficiently by live steam so that it is readily wiped from the highly-finished journal surface. The illustrations show the steaming device which consists of four perforated pipes attached to a manifold which is, in turn, connected by a hose connector to a steam line. The holes in the four pipes are so located that live steam is directed against every part of the journal surface. The steaming unit is covered with a sheet-metal casing which is closed at the end where the steam line enters and which is long enough to fit against the plate of a wheel to give sufficient closure on the opposite end to retain steam for the purpose intended. Journals are steamed for about 45 sec. after which they are readily wiped clean and dry without the use of solvents.

The steaming unit shown is only the experimental one made up of pipe and fittings. Fittings are no longer used, pipe sections being welded directly to the steam manifold.



Live steam is directed against car-axle journals by this assembly before rust-inhibiting agents are wiped from the journals



...ing used in connection with the B. & O.'s steaming unit for cleaning car-axle journals

Air Brake Questions and Answers

HSC Equipment on Passenger Cars and Diesel A and B Locomotive Units Brake Application

275—*Q.—What happens in event of straight air pipe breakage?* A.—In the event of straight air pipe breakage or abnormal magnet valve operation, which would result in loss of auxiliary reservoir air, spring *10* will seat valve *5* and thus retain 75 lb. auxiliary reservoir pressure. This is sufficient to permit an effective pneumatic brake application. The brake valve rotary valve remains in charging position for service applications of the HSC system. Thus the brake pipe pressure is higher on the face of the control valve service piston during applications than auxiliary reservoir air back of the piston, as auxiliary reservoir air is reduced into the straight air pipe at the *21-B* magnet valves. Consequently, the service and emergency pistons remain in release position during HSC electro-pneumatic service brake application.

276—*Q.—On the A locomotive, what is the effect when pressure is built up in the straight air pipe?* A.—Referring to Fig. 32, choke *11* controls the flow of air to chamber *A* on the face of the master controller release diaphragm *18a*, and as the pressure is built up in the straight air pipe it acts on the release diaphragm in opposition to the control pipe pressure in chamber *B*.

277—*Q.—What is the purpose of the pressure in chamber B?* A.—It acts on the application diaphragm *18* and when the air pressure acting on both diaphragms, (*18a* and *18*) is balanced, spring *23* moves the diaphragm shaft *32* and lever *40* to lap position.

278—*Q.—What is the result of this movement?* A.—The application wire contact (Appl) is broken, the application magnet circuit is de-energized, and spring *35* closes application magnet valve *34* of the *21-B* magnets; spring *24* remains compressed however, so the release contact (Rel.) of the master controller remains closed.

279—*Q.—With the release contact closed, what happens?* A.—The release wire and *21-B* release magnets are energized, which holds release magnet valve *62* on its seat.

Increasing Control Pipe Pressure

280—*Q.—What is the result of magnet valve 62 being held on its seat?* A.—Pressure in the straight air pipe is retained to equal the pressure in the control pipe.

281—*Q.—What occurs when control pipe pressure is increased by further brake valve handle movements?* A.—Straight air pipe pressure throughout the train is increased an equal amount by the application operation of the master controller as described.

282—*Q.—On the locomotive, during an application of the brake, what is the course of the air from the No. 21-B magnet valve?* A.—Referring to Figs. *30* and *32*, straight air pipe pressure flows from the *21-B* magnet valve to connection *8* of the D-22-ER control valve, thence through passage *8* in the application and release portion, cavity *n* in the application slide valve *257*, and passage *8a* to the chambers above double check valves *263* and *263a*.

283—*Q.—As the pressure above the double check valves holds them on their lower seats, what is the result?* A.—Check valve *263a* closes off passage *20* leading to the independent application and release pipe, and independent brake valve exhaust. Check valve *253* closes off passage and pipe 3 leading to the displacement reservoir and service portion exhaust passages *3b* and *10* through release slide valve *112*.

284—*Q.—How does the straight air pipe connect up with the relay valve?* A.—This flow continues through passages *16c* and *16* to the FS 1864 or F 1864 relay valve.

285—*Q.—Describe the flow of straight air pipe pressure from the No. 21-B magnet valve during an application of the brakes.* A.—Referring to Fig. 28, straight air flows from the *21-B* magnet valve to the D-22-BR control valve entering connection *8* and passages *8* and *8a* and moving double check valve *288* to its right hand seat, thereby sealing off passage *3*, which is open at this time through cavity *Q* of the release slide valve *11* to exhaust passage *10*.

286—*Q.—What does this movement of the check valve accomplish?* A.—Movement of the check valve uncovers passage *16a* through which straight air pipe pressure flows to pipe *16* and thence to chamber *A* of the *K-3* switch of the FS-1864 relay valve.

287—*Q.—How does this effect the K-3 Switch?* A.—The switch diaphragm *4* is deflected at about 10 pounds pressure against the tension of spring *9*, moving collar *6* and closing contact finger *20* across contact holders *28* and *28a*, thus closing the battery supply wire to the speed governor relays.

288—*Q.—How does the speed governor react to the speed of the train?* A.—The speed governor thereafter energizes or de-energizes the three magnets of the FS-1864 relay valve on each car in accordance with speed.

B Unit Relay Valve

289—*Q.—How is the relay valve on the "B" locomotive unit controlled?* A.—From the speed governor on the *A* unit.

290—*Q.—Describe the flow of control pipe air from the FS-1864 relay valve to the magnet and diaphragm portion.* A.—Air from the control pipe *16* flows through passage *16* and strainer *17* to the magnet portion and to the diaphragm. In the diaphragm portion, the air from passage *16a* flows to the spring chamber of check valves *51*, *51a*, and *51b*, thence to chamber *A* on 40 per cent diaphragm *60*.

Treated Car Lumber*

An increased use of treated car lumber in 1944 is reported by individual railroads as follows. All figures are expressed in feet, board measure.

St. Louis-San Francisco.—Creosoted decking, 1,756,000; salt-treated decking, 272,000; creosoted nailing sills, 234,000; creosoted coal-car sides, 673,000; salt-treated running boards, 52,000; total 2,987,000.

Louisville & Nashville.—Creosoted car decking, 198,645; creosoted saddle blocks, 51,645; salt-treated running boards, 467,708; total 717,998.

Denver & Rio Grande Western.—Creosoted stock-car decking, 170,750.

Atchison, Topeka & Santa Fe.—Creosoted car decking, 254,965; creosoted stringers, 3,336; creosoted tender decking, 10,394; creosoted furring, 8,183; total 276,878.

Texas & Pacific.—Salt-treated stock-car superstructures, 176,000; salt-treated ballast-car decking and siding, 186,000; creosoted stock-car decking, 10,000; total 372,000.

Wabash.—Creosoted hopper-car flooring, 400,000.

Missouri Pacific.—Creosoted stock-car decking, 100,000.

American Refrigerator Transit.—Salt-treated ice bunkers and floor racks, 351,000 ft. b.m. in 1943; 229,000 in 1944.

Wheeling & Lake Erie.—Salt-treated running boards, kiln dried after treatment, were used on new cars and for maintenance, 71,000.

Illinois Central.—Three hundred and fifty stock cars were repaired partly with treated lumber, completing a program started in 1943 when 800 stock cars were repaired. All decking and nailing stringers were creosoted. Roof boards, side slats and other members were salt treated.

Delaware & Hudson.—Box-car vertical sheathing and running boards are salt treated and kiln dried after treatment. Running-board saddles and side-sill fillers on box cars are creosoted. For open-top cars, creosote treatment is used on flooring, floor nailers, hopper supports, slope supports, slope and hopper plank and copings.

Western Maryland.—Steel-sheathed box and automobile cars are to have salt-treated lining and flooring.

* Report of Committee 7-11 "Uses of Treated Wood for Car Lumber," prepared for the April 24, 1945, annual meeting of the American Wood-Preservers' Association.

Creosote, 6-lb. distillate treatment, steamed for three hours after treatment to provide clean surfaces, is used for flooring flats and gondolas.

Lining and side decking of locomotive cabs, decking between locomotive tender tank and frame, lining for cabooses and some running boards for box cars are salt treated. Lining is kiln dried to 10 per cent; flooring to 15 per cent moisture content after treatment.

Pennsylvania.—In November, 1944, the Pennsylvania issued instructions and specifications for the treatment of car lumber. The initial program covers the rebuilding of wooden parts on 100 box cars of the X26 type and 25 stock cars of the K7 type. All material to be fabricated before treatment.

Lumber required for the 100 box cars includes 131,250 board feet of flooring, 11,214 board feet of floor supports, 5,612 board feet of floor fillers, 9,056 board feet of longitudinal running boards and 2,100 board feet of latitudinal running boards; a total of 159,232 board feet. This lumber is all southern yellow pine treated with CZC to a retention of ¾ lb. of dry salt per cu. ft., kiln dried after treatment and before shipment to the car repair shops.

Material required for the 25 stock cars includes 32,812 board feet of flooring, 2,803 board feet of floor supports; 1,403 board feet of floor fillers; 2,274 board feet of longitudinal running boards; 495 board feet of latitudinal running boards, and 95 board feet of end battens—a total of 39,882 board feet. This lumber is also southern yellow pine. The flooring, floor supports, and floor fillers are treated with distillate creosote to a retention of 6 lb. per cu. ft. and steam cleaned. The running boards and end battens are treated with CZC to a retention of ¾ lb. of dry salt per cu. ft. and subsequently kiln dried.

Chicago, Burlington & Quincy.—During 1943 1,190 stock cars were repaired using 24,628 pieces of 2 in. by 6 in. by 8 ft. 10¾ in. and 15,992 pieces of 2 in. by 6 in. by 9 ft. 7⅜ in. treated decking. Last year in building 200 new stock cars there were used 420 pieces 1½ in. by 4 in. by 8 ft. 11½ in. treated decking; 10,917 pieces 1¾ in. by 7¾ in. by 8 ft. 11½ in. treated decking; 2,107 pieces 1¾ in. by 7¾ in. by 9 ft. 7½ in. treated decking.

Additional treated material would have been used if it could have been secured in time for framing and treating and still maintain the stock-car-building program.

Service Records

Missouri-Kansas-Texas.—We have no special record of treated lumber used on our cars. Rather we are guided by inspections and observations. We have found that treating decks and nailing stringers on open-top cars prolongs very materially the life of these parts, more than doubling it. Under ordinary conditions we use treated black gum for the decks and where breakage does not occur through use of clam shells, our maintenance charges have very materially been reduced.

Great Northern.—In 1925, we had 500 stock cars, Nos. 53500 to 53999, built at the Siems Stemble Plant, St. Paul, Minn. These cars had wooden side sills, end sills, body framing, flooring and roofing creosote treated. There has been very little replacement of parts because of decay failures. This means that the life of end sills, side sills and side plates in particular was doubled or tripled, compared to untreated materials. This is a fair criterion of what may be expected from the treatment of wooden parts that are highly subject to decay failures.

Atchison, Topeka & Santa Fe.—The creosote treatment we have used has caused lumber to resist decay better than untreated lumber and we can increase life of this lumber from six to eight years by treating it. On some of our flat cars where we applied full creosoted decking using the Rueping process, the life of this decking was 12 to 15 years, compared with 4 to 6 years for untreated decking.

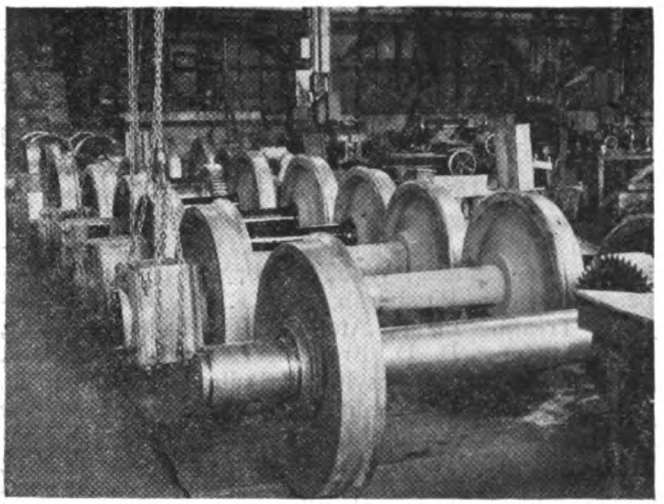
(This report was signed by H. R. Condon (chairman), vice-president, Wood Preserving Division, Koppers Company, Pittsburgh, Pa.; R. S. Belcher, manager,, Treating Plants, Atchison, Topeka & Santa Fe, Topeka, Kan.; P. D. Brentlinger, resident inspector, Forest Products, Pennsylvania Railroad, Philadelphia, Pa.; C. M. Burpee, editor, Railway Engineering & Maintenance Cyclopedia, Chicago; R. F. Dreitzler, secretary-treasurer, West Coast Wood Preserving Co., Seattle, Wash.; D. R. Elmore, assistant to general manager, Fruit Growers Express Co., Washington, D. C.; R. C. Enste, assistant lumber agent, Baltimore & Ohio, Baltimore, Md.; T. J. Flynn, American Lumber & Treating Co., Jacksonville, Fla.; B. M. Goodwin, district manager, Wood Preserving Division, Koppers Company, Montgomery, Ala.; G. C. Hannaway, vice-president, T. J. Moss Tie Co., St. Louis, Mo.; L. W. Kistler, superintendent, Treating Plants, St. Louis-San Francisco, St. Louis, Mo.; E. H. Rieman, E. I. du Pont de Nemours & Co., Inc., Grasselli Chemicals Dept., Wilmington, Del.; C. S. Sizemore, assistant manager, Forest Products Bureau, Illinois Central, Memphis, Tenn.)

Machining Car Axles

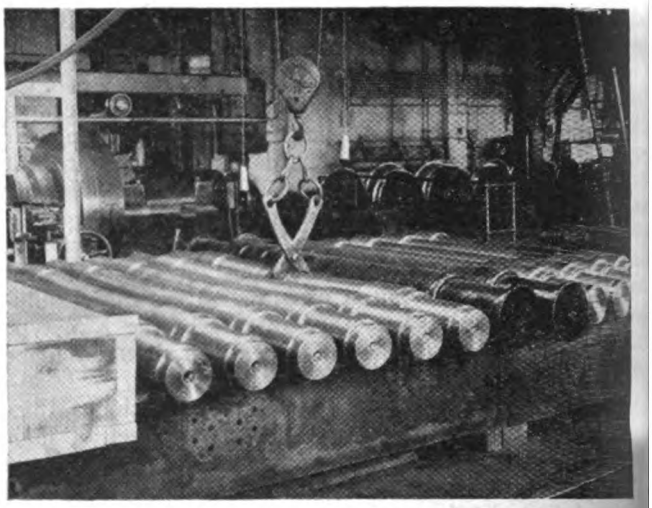
The problem of machining axles for modern high-speed car equipment and Diesel locomotives is vastly different from the former practice of machining car axles, many of which required only rough turning between the wheels and could be finished in a center-drive axle lathe in one hour or less per axle. The severity of the service to which modern streamline equipment is put requires particular attention to the surface condition of all highly stressed steel parts and some roads follow the practice of grinding axles all over after being machined, also rolling or burnishing fillets, to remove any surface imperfections which might be the cause of progressive fractures.

In the case of the Rocket trains of the Chicago, Rock Island & Pacific, a method of machining has been developed and is now being followed at the 47th Street, Chicago, shops which utilizes tungsten-carbide tools in a modern lathe to produce exceptional accuracy and smoothness of finish, so that subsequent grinding is not necessary except to meet some other requirements such as the application of roller bearings. In the entire operation of machining these axles, however, emphasis is placed on accuracy and a high degree of finish at some sacrifice, if necessary, in production.

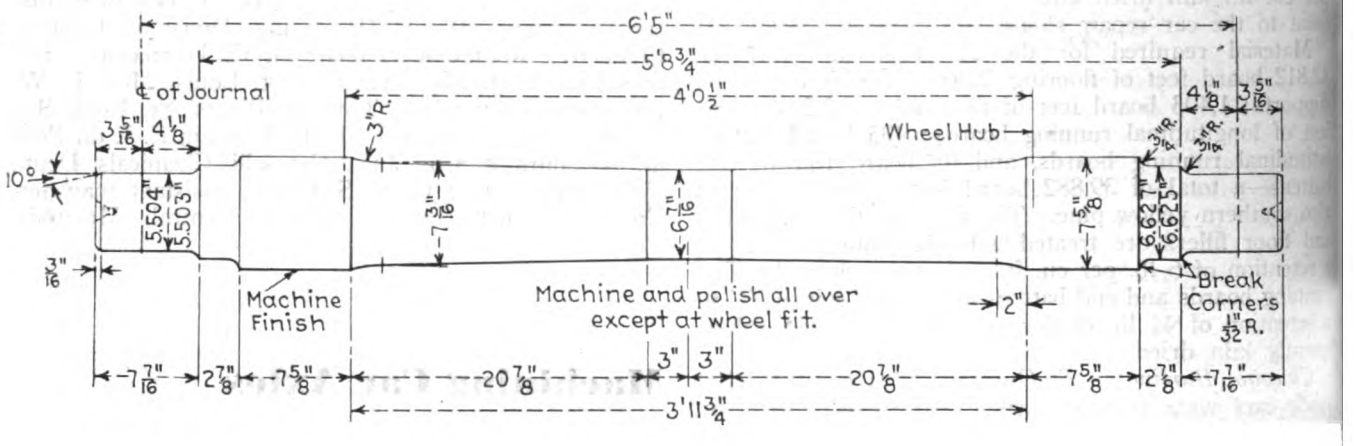
Rocket car and power unit axles are machined at the Rock Island shops on an American 24-in. by 8-ft. heavy-duty engine lathe, driven by an electric motor with push-button control and equipped with a 24-in. four-jaw independent chuck, steady rest and profile attachment for use in machining the double taper on axles. In machining axles on this engine lathe, using tungsten-carbide cutting tools, the spindle speed is 162 r.p.m., or 365 ft. per min. surface speed, with .012 in. feed in roughing. For finishing, the spindle speed is 228 r.p.m.,

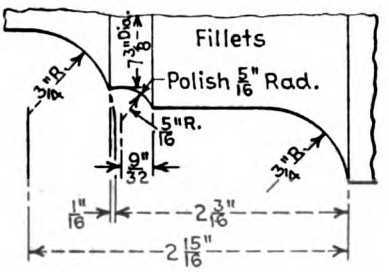


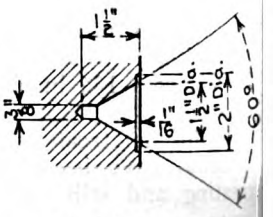
Wheels and axles which have been turned and mounted ready for service under streamline train equipment

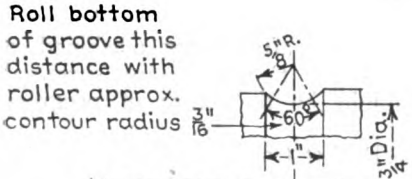


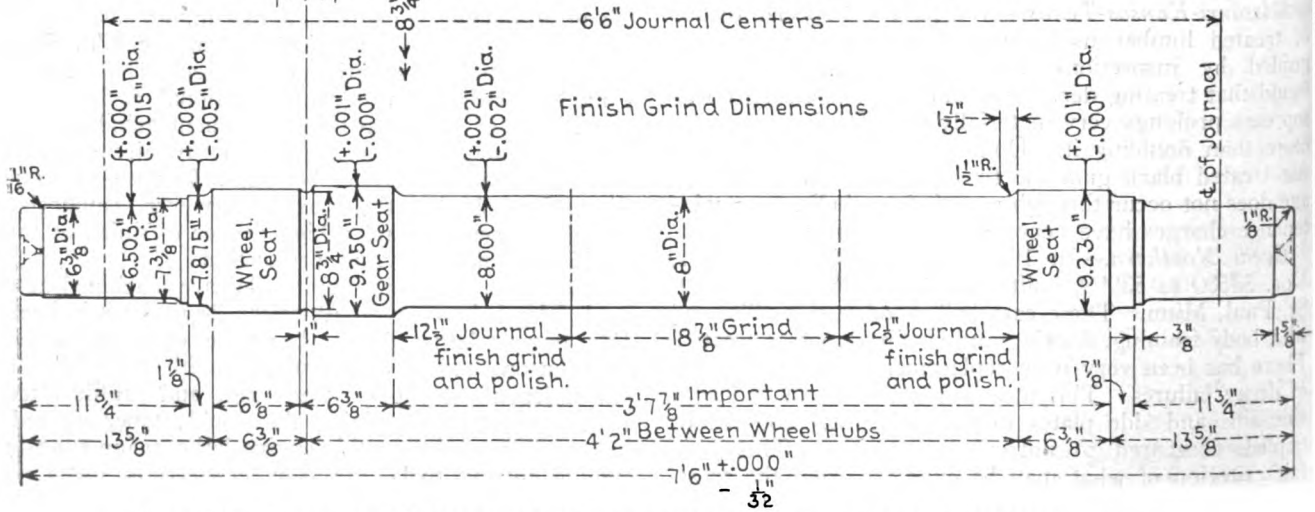
Completed axles machined and assembled ready for use at the 47th Street shops









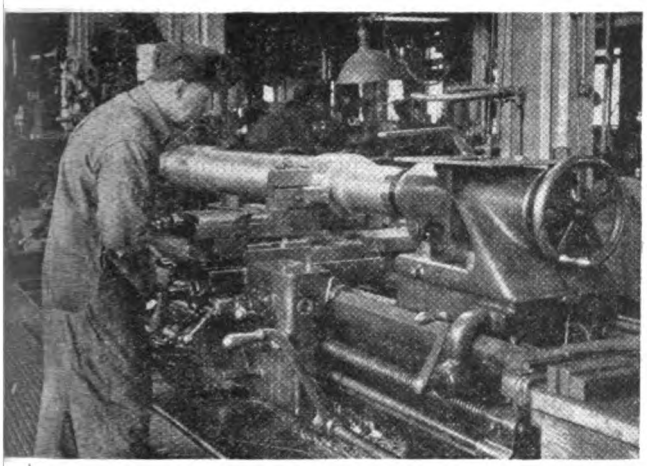


(Above) Finish dimensions of Rocket car axle with 5-in. by 9-in. journals — (Below) Rocket Diesel locomotive axle

or 478 ft. per min. surface speed, with a feed .006 in. per revolution.

Cutting tools used on this lathe are ground on a Hammond bench type grinder, shown in one of the illustrations. The 100-grit diamond-impregnated wheel on the left is a 6-in. plain cup-type wheel with ¾-in. rim used for grinding cutting tools to standard rakes and clearances as follows: front relief, 6 deg.; side relief, 4 deg.; side rake, 8 deg.; back rake, 0 deg. The tool is offset 23 deg., right or left, which includes the side rake. The tool bit is made of tungsten-carbide steel, milled and brazed. It is ground the same both for roughing and finishing cuts, except that a somewhat softer alloy is used for the former.

An important feature of tools used in this high-speed



The highly polished axle end is secured with a tungsten-carbide cutting tool

turning with light cuts is the chip breaker groove, which is ground on the 4-in. diamond wheel at the right. This wheel has a 1/16 in. diamond-impregnated square face with corners chamfered 1/64 in. A 250-grit wheel, operating at 3,450 r.p.m., is used. The chip breaker groove is ground just back of the cutting edge and serves to break the chip as it curls off the axle. A slightly deeper and wider groove is required for roughing than for finishing cuts.

Tungsten-carbide cutting tools ground in this way are maintained with keen cutting edges by means of a diamond hone and require about one grinding per 8-hr. day. Under the high surface speed used in this operation, a heavy stream of coolant is required to keep the tool temperature within the desired limits.

Carbon-steel axles are received from the steel mill, normalized, tempered and rough-turned about 1/8 in. large in diameter by 1/8 in. longer than finish blueprint size. In operation, the axle is put between centers in the engine lathe, being driven by a face plate and lathe dog on the left end, with a roller-bearing center in the tail stock. The axle end is faced for length and the right half rough turned .040 in. over the finish size, the axle then being reversed and the other half rough turned. The next operation is to chuck one end of the axle, apply a roller bearing steady to the opposite journal and true the axle center accurately to 6 deg. with 1½ in. outer diameter. A 1/16-in. by 2-in. counterbore is also machined in the end of the axle as shown in the drawing to avoid any possibility of upsetting or deforming the axle center in the wheel press.

The steady rest is removed and the axle again put between centers, ready for finish turning. Referring to the car axle drawing, the 7 5/8-in. wheel seat is turned first, then the dust guard seat, journal, and finally the taper section at the axle center, using the profile attachment at the back of the lathe. The axle is then reversed in the lathe, using due care to protect the journal against scarring by the lathe dog, and the operations repeated for the other end. This axle was formerly specified to be ground all over which took considerable extra time and was a difficult job, especially with the equipment available at the Rock Island shops for grinding the center tapers. With the smooth, accurate and high-gloss finish provided with tungsten-carbide tools at high surface speeds, grinding is no longer necessary or required, except for dust-guard seats and roller-bearing seats which are ground to permit pressing the races off and on when necessary without losing the fits. Sharp corners are broken and all fillets are ground, thus assuring freedom from tool marks and scratches.

If possible, even greater care is exercised in machining Rocket Diesel locomotive axles, like the lower axle in the drawing. This carbon-steel axle, normalized and tempered, is rough turned about 1/8 in. above the finish size and then finished with an allowance of .010 in. for grinding all over, except for the end shoulders which are turned and a relief groove which is rolled. Grinding is necessary not only because of the application of roller bearings but for electric-motor-support bearings on the straight section between the wheels on the power axles.

The various parts of this axle are finished in the following order: Gear seat, wheel seat, dust guard, journal seat, end shoulder of axle, motor support bearing on the center of the axle. A relief groove, provided between the gear and wheel seats, has a 5/8-in. radius by 1-in. wide by ¼ in. deep and is polished with fine emery cloth and rolled. The oil-seal groove or fillet on the end of the dust guard is then machined and polished. All other fillets are turned and ground. The axle is then reversed in the engine lathe and a similar procedure followed for the other end. Approximately 8 hr. is required to machine this axle in the engine lathe and 4 hr. for grinding.

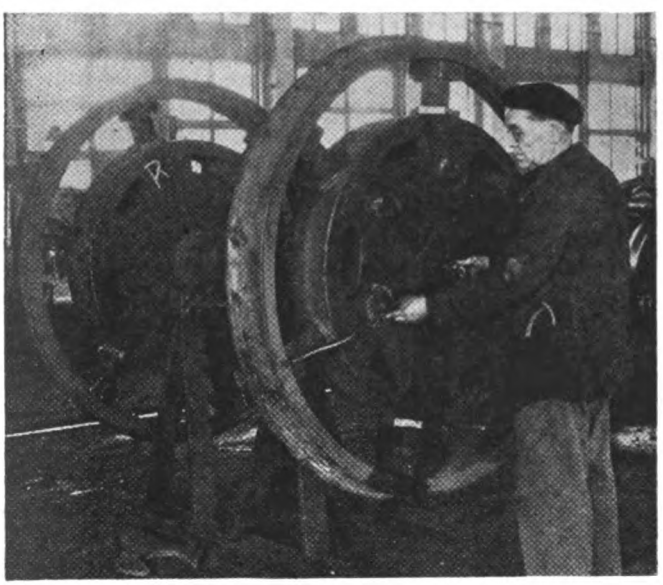
Referring to one of the other illustrations, axles shown at the left are six-roller-bearing tender axles. Those in the middle include two road switcher axles painted to protect against rusting. The axles at the right are for a 5,400-hp. Diesel freight locomotive. Another illustration shows a miscellaneous group of wheels and axles being reconditioned at the 47th Street shop of the road.

Hammond grinder with diamond wheels used in grinding standard cutting tool rakes and clearances, also chip breaker grooves

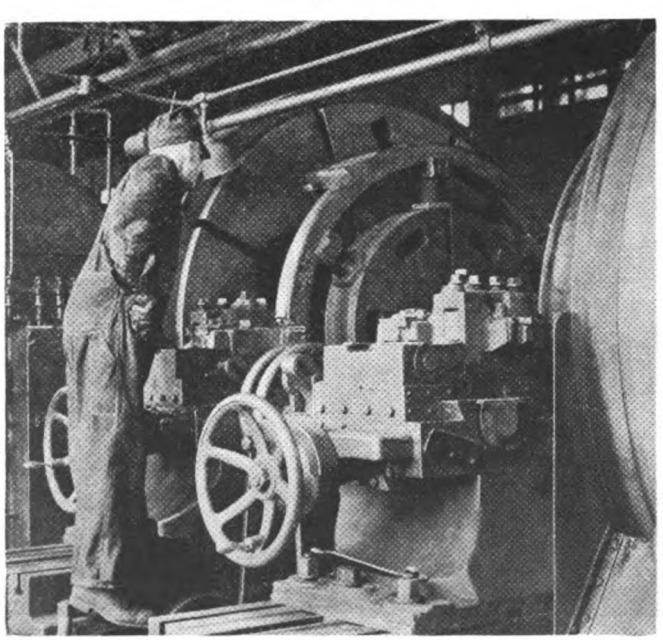
Tire-Turning Mandrel

When necessary to turn unmounted driving-wheel tires either singly or in pairs, some railroads keep dummy wheel centers on which the tires can be mounted and placed in the driving-wheel lathe for refinishing the flange and tread contours and turning to size. The special mandrel illustrated is used for this purpose at the Oelwein, Iowa, shops of the Chicago Great Western.

The mandrel consists simply of two cast-iron wheel-center blocks, mounted on an axis and equipped with six large adjusting screws (for each block) and nuts which can be used to adapt the mandrel easily and quickly for tires ranging from 48 in. to 56 in. inside diameter, or 66 in. using dummy spacing rings. A lip on the head of each adjusting screw holds the inside face of the tire square with the axis center line and the adjusting screws are set to make the inner tire diameter accurately concentric with the axle by means of a center gage. Also illustrated is a pair of tires being turned on the mandrel in a wheel lathe.



How tires are centered on the mandrel



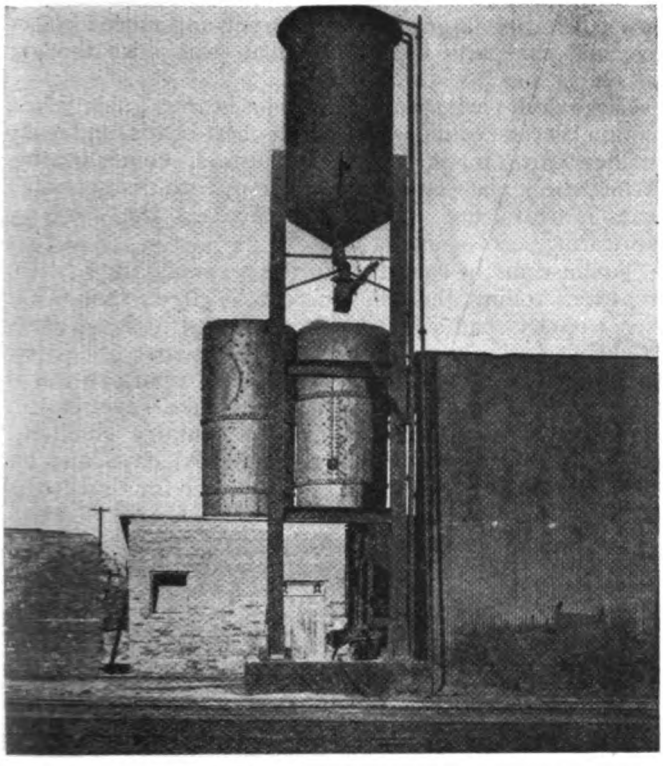
Turning tires on a mandrel at the Oelwein shops of C. G. W.

Generally speaking, there is only one way to make absolutely sure of accurately round and concentric driving-wheel tread contours and that is to turn the tires after they are applied to the wheel centers on which they will operate, which is standard practice whenever tires are turned for classified or other heavy repairs. With due care in using the mandrel, however, reasonably accurate results are secured and the practice is more than justified for at least two reasons: tire metal is conserved, because the use of this mandrel permits replacing tires with sharp flanges, for example, and thus avoids turning an excessive amount of serviceable wear metal off the other tires. Moreover, the job of switching tires can be performed at outlying terminals without sending locomotives to the back shop or an enginehouse equipped with a wheel lathe. Unnecessary expense, delay and loss of locomotive service time are thus avoided.

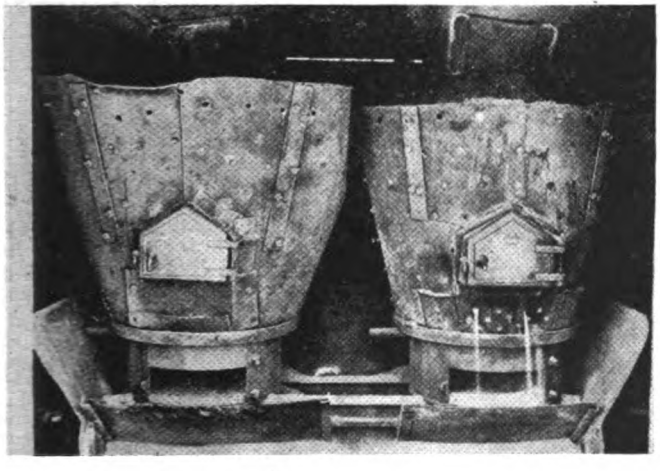
Sand Drying at Oelwein Enginehouse

One important recent improvement at the Chicago Great Western enginehouse, Oelwein, Iowa, is the provision of new facilities for drying sand and delivering it to locomotives, as shown in the illustrations. By the method formerly employed at this point, sand was unloaded with a derrick hoist and clamshell into an open storage bin 73 ft. long by 7 ft. 10 in. wide, from which sand was shoveled by hand into a hopper leading to two drying units located at ground level and delivering sand to a pressure tank set in the ground underneath. From here, sand was blown to an overhead storage tank and subsequently delivered through suitable pipe and hose connections to the locomotive sand boxes. Not only was a hand-shoveling operation involved in filling the hopper, but, when the level of sand in the storage bin got low, the sand had to be shoveled into a barrow and wheeled up a ramp to the hopper platform, thus involving additional manual labor.

By use of the new equipment, all manual handling of the sand is eliminated. Sand is unloaded from the car with a clam shell directly into two three-course scrap boiler shells mounted vertically on a steel framework directly above the sand dryers which are enclosed in a brick sand house as illustrated. These boiler courses are 85 in. in diameter by 17 ft. 5 in. high, mounted side by side and in fact riveted together at the top courses which are in contact. Sand works from the boilers down through dryers to a 40-in. by 6-ft. pressure tank placed vertically in a concrete pit 6 ft. square by 11 ft. deep directly underneath. From this pressure tank, sand is delivered through a 2½-in. double-strength steel pipe to a 15-ton storage tank, located about 40 ft. above rail level and supported, when first installed, from the coal shed and more recently



Front view of new sand-handling plant at Oelwein enginehouse



The two coal-fired sand-drying stoves in operation

from two 10-in. steel I-beams set firmly in a concrete foundation. Sand passes to the locomotive through a suitable pipe and 4-in. rocker gate valve to a slip-joint pipe extension which delivers sand to either large or small locomotives and permits filling sand domes with dry sand in about 3 min. each.

By the former method, one man was required on each 8-hour shift in winter to feed sand to the hoppers and tend fires in the sand-drying stoves. In summer, only one man was required on each of two eight-hour shifts. By the present method, the only manual labor involved is tending the fire which has to be refueled about three times during an eight-hour shift and the ashes and clinkers removed once in eight hours, this work being done by the coal dock operator.

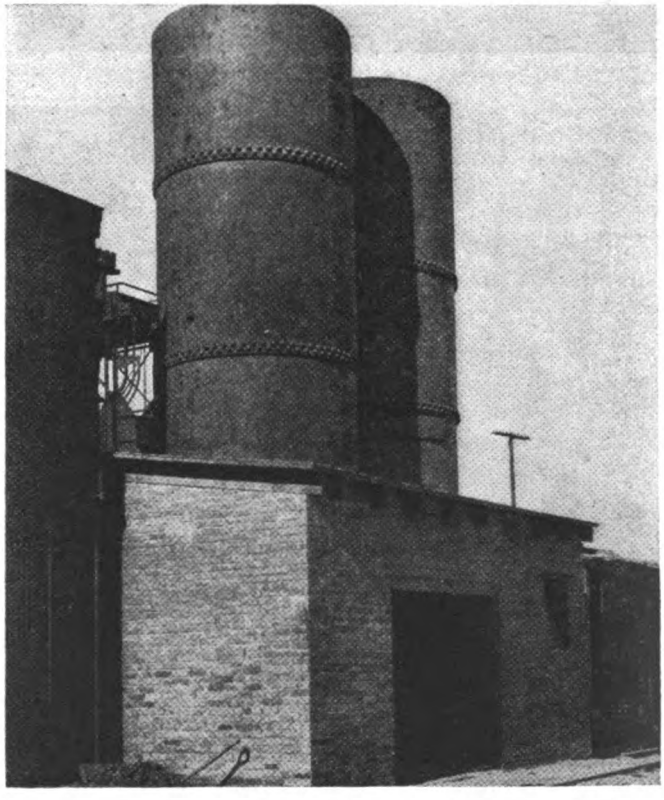
Sand for the Oelwein enginehouse is received from Waterloo, Iowa, in open-top gondolas and 40 tons of sand are put directly into the scrap boilers, the balance of the load, only, being placed in the storage bin and thus subject to double handling. The two boiler shells are filled to the top and this moist sand given a preliminary heating by the smoke pipes which extend up through it.

When necessary to refill the pressure tank in the concrete pit, air pressure is exhausted and the sand is fed by gravity through a gate valve until the tank is filled, at which time the gate valve is closed and air pressure reapplied to the tank. Opening another valve located at ground level admits air to an injector at the bottom center line of the pressure tank which blows a combination of air and sand up the vertical pipe and over a short crossover pipe to the sand storage tank overhead. It generally requires about 9 to 12 minutes to fill the storage tank. Tees are installed at all bends to minimize cutting and these tees will usually last about three months. The air pressure utilized is about 105 lb.

The boilers are open at the top and funnel-shaped at the bottom where they deliver sand to the two sand stoves placed side by side in the brick sand house. These funnels are off center so the stoves can be placed near together. The top edges of the stove hoppers are located about 8 in. below the point of delivery of the sand in funnels so they will not overflow. The two stove smoke pipes, made of $\frac{3}{16}$-in. steel, 9 in. in diameter, extend up through the boilers and 12 in. above the top where deflectors are applied to keep sand out of the pipes. The length of these stove pipes assures excellent draft and gives a preliminary heating of the sand which saves fuel.

Moist sand feeds down around the stove firebox and as it dries falls to a screen of $\frac{1}{8}$ in. mesh wire, then dropping to the hopper with gravity feed to the pressure tank underneath. The screen is set on an angle of about 25 deg. so that fine sand drops through and coarser particles roll to the bottom on a steel shoveling sheet from which they are thrown out with the cinders. The stoves are hand fired with regular coal about three times in eight hours and the ashes removed once each eight-hour shift.

Demonstrated advantages of this plant includes a substantial saving in manual labor; avoidance of double han-



Rear view of the sand storage boilers and sand-drying house

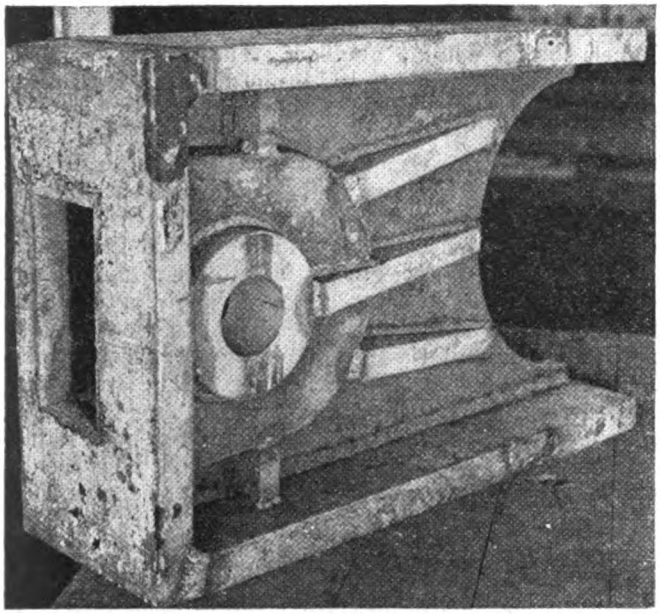
dling for most of the sand, some economy in fuel and the provision of an adequate supply of fine dry sand where and when needed.

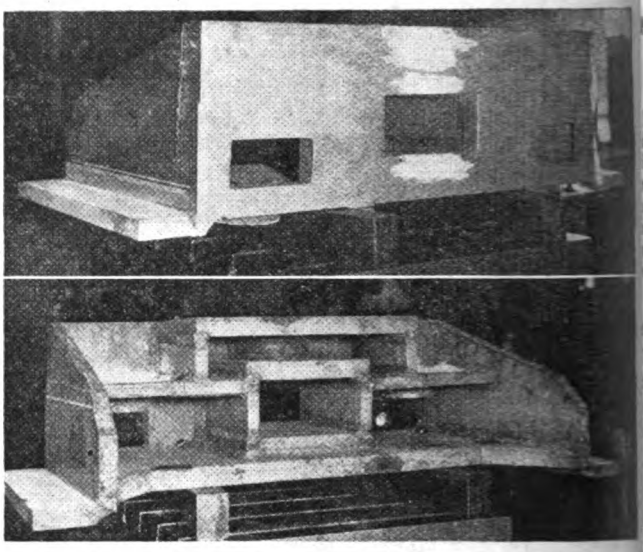
Welded Steel Parts

Steel foundries are working night and day, turning out material for the war effort, and orders for steel castings for locomotives and cars are sometimes subject to lengthy delays in being filled, particularly in the case of western carriers. In order to avoid keeping vital and much-needed locomotives out of service unnecessarily long when steel castings fail, the welding shop of the Southern Pacific, at Sacramento, Calif., has extended its operations and is now fabricating larger items and producing more locomotive and car parts by welding than was once thought possible.

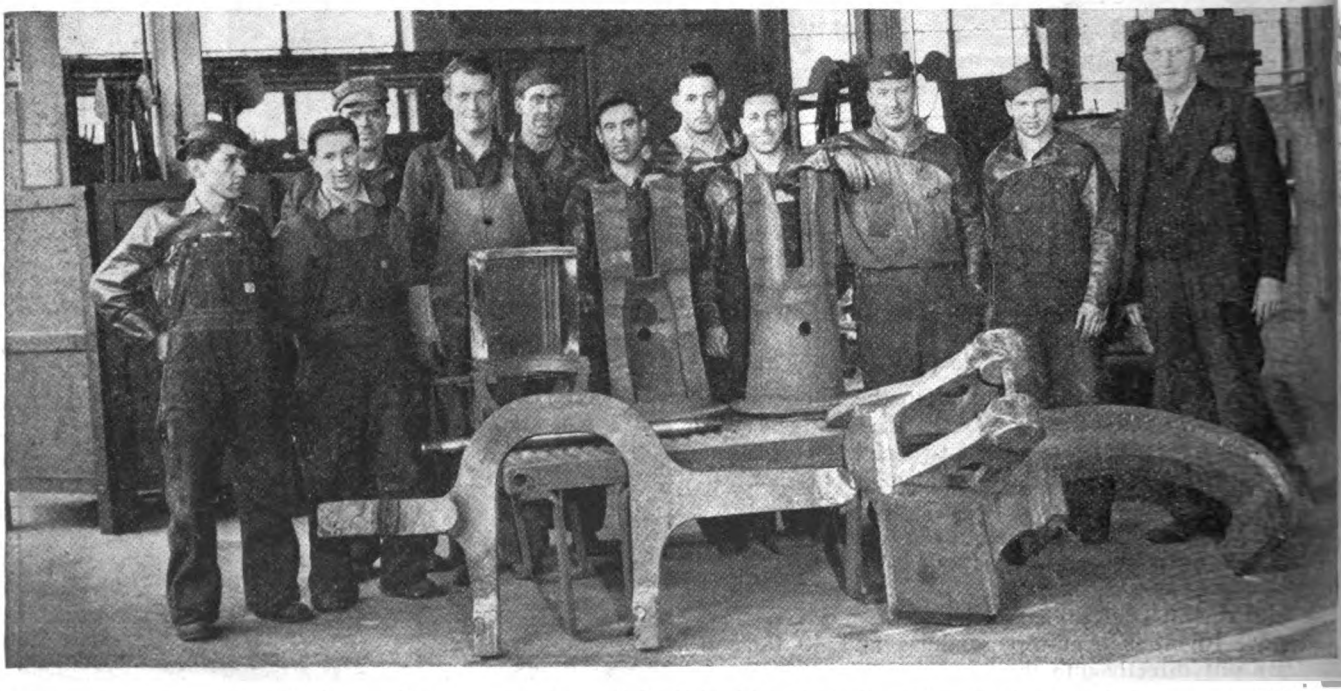
Large deck parts, drawheads, pilot beams, guide yokes, motion bearers, cylinder and steam-chest heads, and many smaller parts for locomotives, bolsters, center-bearing arches, check plates and drawbar stops, with many smaller parts for cars, are now manufactured in the shops by fabricating.

To illustrate the part that fabrication is playing in keeping trains rolling, the following case is cited: One of the larger tenders had a failure of the front drawhead which fits between the frame and takes the drawbar and safety bars that connect with the locomotive. No pattern was at hand to make this part and it would take seven to ten days to make a pattern. The steel foundry could not promise delivery of the casting under 90 days and the locomotive could not be held out of service for that length





Left and above: Two types of front drawheads for tenders, fabricated by welding



Welding force and typical work done at the Sacramento shops of the S. P.—Transmission bar and guide yoke shown in foreground; driving box cellars and back steam chest heads on skid

of time. The drawing of the part was checked and necessary steel detail parts cut to shape ready for fabrication. The part was welded, annealed, finished, ready for the tender in five days and was on the tender and in service by the end of the sixth day.

Fabricating a locomotive or car part consists of cutting with an oxyacetylene torch on a pantograph machine of the various detail parts from steel plates. These parts are fitted together with suitable jigs and welded in place by the electric process, after which the part is annealed in a furnace. Finishing and drilling is done in the machine shop in the same manner as a steel casting would be finished. The resulting product is then applied to the locomotive.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Tender Deck Height

Q.—The I. C. C. rules state that the difference in height between the deck on the tender and the cab floor or deck on the locomotive shall not exceed 1½ in. Does it make any particular difference which one is above the other?—F. E. M.

A.—The rule does not make any distinction. The general practice is to have the tender deck one inch lower than the engine deck, when the tender is fully loaded. The tender deck height varies approximately two inches between the loaded and light conditions, and, therefore, varies in height from one inch below to one inch above the engine deck level.

Injecting Sand Into Oil-Burning Fireboxes

Q.—Why is it necessary to feed sand into the firebox of an oil-burning locomotive? Is this practice detrimental to the life of the firebox?—E. S. C.

A.—Sand is injected into the firebox of an oil-burning locomotive at frequent intervals for the purpose of cleaning the soot from the tubes and flues. The sand is passed into the firebox through a hole in the firedoor where it is picked up by the draft and drawn through the tubes and flues cleaning them as it passes through. It results in a reduction in the life of the firebox sheets, tubes and flues.

Cinder-Cutting Problem

Q.—We have considerable trouble with cinder cutting of flues at the point where they have been expanded in the rear tube sheet. The expanding of the flues in the rear tube sheet makes a ridge around the flue at this point and cinder cutting results. Could the life of the flues be extended by building up the thickness of the flue at this point by electric welding?—M. I. R.

A.—It is not recommended that flues be built up by welding at this point; the projection of the weld would, in effect, close up the flue area still more and increase the likelihood of cinder cutting. Welding at this point would also have a detrimental effect on the copper ferrules inserted between the flues and the tube sheet if ferrules are used. It would be better practice to apply a heavier gauge safe end on the flue, making the safe end from 12 to 15 in. long. This would give increased flue thickness at the point of cinder cutting and lengthen the life of the flue.

Forced Cooling Of Locomotive Boilers

Q.—What is meant by forced cooling of a locomotive boiler? What procedure is followed?—A. M. F.

A.—Forced cooling is used when there is not sufficient time to permit a boiler to cool naturally before washing it. At locomotive terminals equipped with blowdown facilities, the blowoff cock on the locomotive is connected to the blowdown line and the boiler is filled from the injector. The blowdown is regulated to keep a visible indication in the water glass. After the steam pressure is lowered to a point where the injector will not work, the blowoff cock must be closed for a period of 15 min. after which the blowoff cock is again opened until the steam pressure is reduced to the point where it is no longer sufficient to force the water through the blowdown system. When this condition is reached the pipe to the blowoff cock is disconnected and the boiler is drained into the pit. The blowoff cock should be choked so that the boiler is blown of all water and steam in approximately 1½ hours.

Renewal of Front Tube Sheets

Q.—We have several boilers on our Pacific-type locomotives which have front tube sheets from 10 to 12 years old. These tube sheets have developed cracks in the knuckle along the bottom of the boiler. Should the sheets be renewed at this time or would it be satisfactory to repair them?—F. I. K.

A.—The actual age of the front tube sheets is not as important as the condition of the sheets in determining whether or not they should be renewed or repaired. Any portion of the tube sheets still in good condition should be retained. Tube sheet defects are generally found in the tube and flue area and in the knuckle along the sides and bottom of the tube sheet. The tube sheet should be examined carefully for all defects, such as pitting on the water side, cracking in the knuckles, and cracking around the tube and flue holes caused by excessive rolling and working of the tube and flues when the holes have become enlarged. The stayed portion of the tube sheet is generally found to be in good condition as compared to the rest of the sheet. General practice is to renew that portion of the tube sheet which is found to be defective, butt-welding the new and old portions of the sheet.

Cracked Throat Sheets

Q.—Would running a locomotive after the removal of the lagging and jacket from the throat sheet and throat sheet corners, result in cracked throat sheets?—F. E. L.

A.—Cracked throat sheets can be the result of any of the following conditions: Strains due to unequal expansion and contraction; rigidity of construction at the throat sheet; improper flanging of the throat sheet in either heating or forming; over-rapid firing of the locomotive; changes in temperature caused by flow of water; strains set up due to the rigidity of the connection between the front of the firebox and the engine frames; failure to properly maintain the free movement of the sliding blocks between the front of the firebox and the frames; or crystallization of material due to working. While the removal of the lagging and jacket from the throat sheet and throat-sheet corners would expose the sheet, with a resultant cooling effect which could result in strains due to expansion and contraction, it does not necessarily follow that this would be the direct cause for a cracked throat sheet.

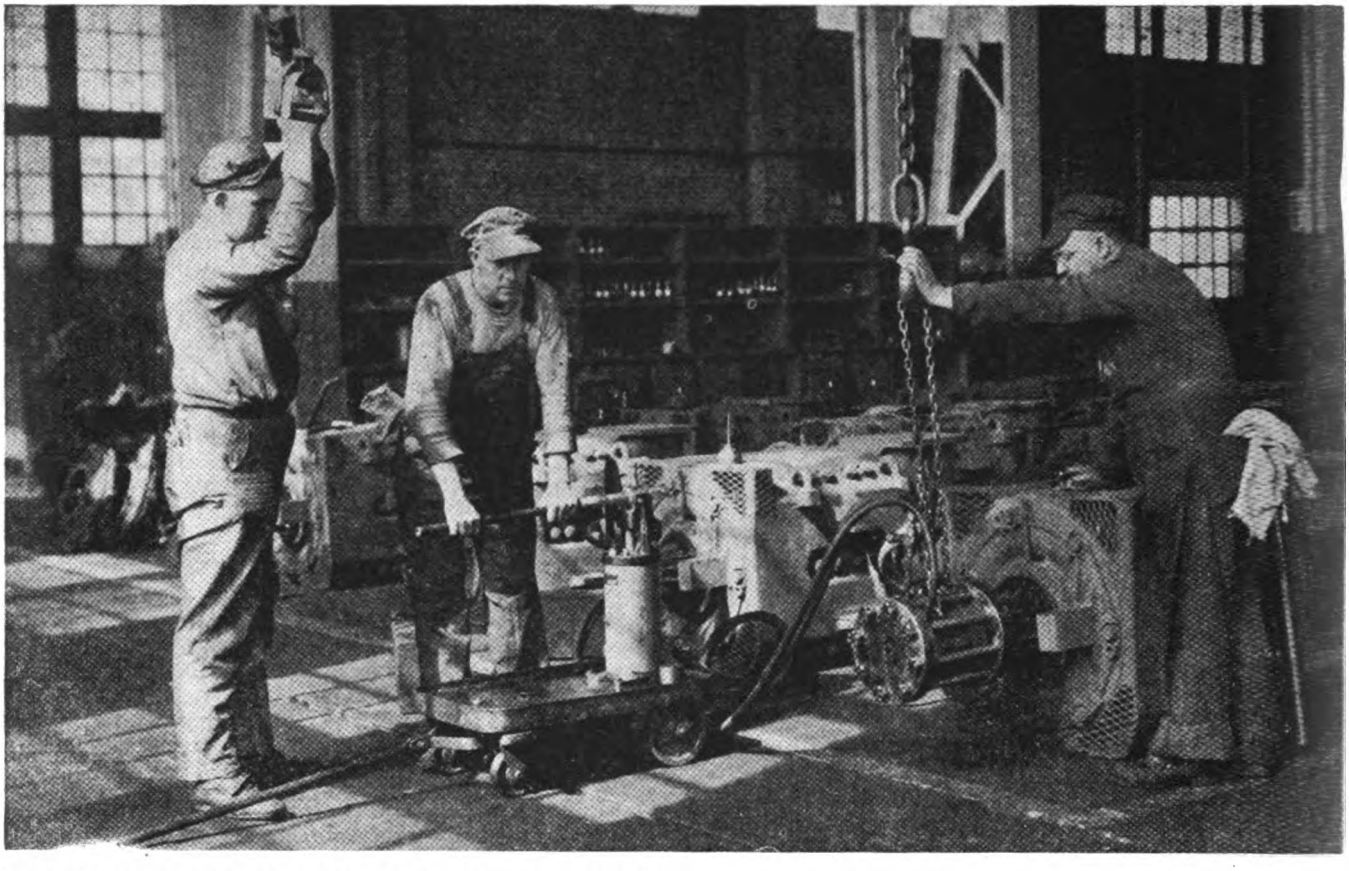


Fig. 9—Pinions are pulled with a hydraulic puller, the crane being used to support the puller head during the operation

Electrical Shop for Diesels

Part II

Southern installs new facilities at Atlanta, Ga., for overhaul and repairs of all traction motors and generators used on Diesel - electric locomotives

THE first operation in traction-motor overhaul consists of pulling the pinion (Fig. 9) and disassembling the motor. Frames are cleaned in one cleaning bay equipped with an exhaust fan, and armatures in another. The cleaning is done with spray nozzles operated from shop air pressure, using a solution consisting of a half-and-half mixture of carbon tetrachloride and Gulf Standard solvent. Exhaust fans at the back of the booths keep the shop and the booths free of cleaning vapors.

Work schedules and work reports are divided primarily between the work done by the shop crafts, mechanical and electrical. Thus there is a Mechanical Assembly Report, an Armature Report, and a Field Coil and Frame Report, covering all work done on traction motors. There is another report on generators but it is not included with this article. When the work is finished, the electrical shop fills out its own shop record card, referred to previously as Fig. 6, and makes out a Summary-of Work Performed, which is sent to the Diesel superintendent.

After the armature has been removed from a frame, brush holders are removed and coils are inspected for looseness and defective insulation. Brush rigging is overhauled if necessary. A standard brush is passed through all carbon ways to insure free movement.

Summary of Work Performed

Name of equipment ..... Serial No. .....
Type or style ..... Manufacturer .....
Date rec'd in shop ..... From .....
Date out of shop ..... Shipped to .....
Removed from unit ..... Reason .....
Mileage this application .. Accumulated .... Armature .....
Approximate cost of repairs—Labor .....
..... Material ..... Total
Disassemble and clean field frame, armature, bearings and bearing parts .....
Impregnate armature ..... Balance armature .....
Armature Serial No. .....
Finish commutator ... Undercut mica ... Burr bars .....
Check field frame for loose coils, dip and bake .....
Overhaul brush holders .....
Are bearings new or old C.E. ..... P.E. .....
Apply high potential test of ..... VAC to armature
..... VAC to frame .....
Overhaul external leads, terminals and blocks as necessary .....
Apply bearing test run and observe operation — Results .....
Apply Pinion No. ..... Advance .....
New or old ..... No. of teeth .....
Note Below Any Special Work Performed
Note 1. .....
Note 2. .....
Note 3. .....
Note 4. .....
Note 5. .....
Report No. ..... Date .....
Foreman motor shop .....

As noted previously, field frames with coils in place are spray-cleaned. From the cleaning bay they are transferred to one of the bake ovens where they are maintained at 115 deg. C. for 12 hrs. While still hot, pole-piece bolts are checked for tightness, after which frames with coils in place are spray painted with black air-drying varnish. Facilities will be provided for dipping and baking fields and frames as a unit.

Motor leads are cleaned and reinsulated. Wood cable cleats are removed, cleaned, painted and reapplied.

When it becomes necessary to remove field coils or pole pieces, the work is facilitated by a frame positioner which permits rotating the frame so that the coil to be removed is always at the bottom.

Field Coil and Frame Report

Motor Serial No. ..... Job. No. .....
Type or Model No. ..... Manufacturer .....
Megger reading of field frame before cleaning .....
Is there any indication of thrown solder in frame .....
Examine frame for loose or chaffed coils .....
Clean frame and preheat ..... hours at ..... deg. C.
Chart No. .....
Tighten all pole bolts while frame is hot (before dipping) .....
Dip in varnish and bake ..... hours at ..... deg. C.
Chart No. .....
Are all brush holder support brackets tight
(Test with hammer) .....
Does brush holder clamp bolts turn freely to extent of threads .....
Condition of internal cables and connections .....
Paint frame and coils with two coats of air-drying varnish .....
Remove and clean external cable cleats .....
Renewed .....
Condition of rubber frame grommets .....
Renewed .....
Condition of cable hose ..... Renewed .....
Terminals ..... Renewed .....
Are cap screws to pole piece on axle side welded .....
Reseal rubber frame grommets and top pole bolts .....
Clean connections and install brush holders in frame .....
Megger reading before applying high potential test .....
Apply high potential test of ..... volts a.c. for ..... seconds

Armature Reconditioning

After cleaning, armatures are preheated at 115 deg. C. for 12 hours. While still hot they are placed in the vacuum impregnator where they are impregnated with Sterling R-583-Y varnish. The varnish is given weekly tests to assure its having a specific gravity of 0.875 plus or minus 0.005 at 70 deg. F. It must also pass a Ford cup test for viscosity of 30 to 50 seconds at 70 deg. F. Thinner is added as needed to maintain proper values. After impregnation, armatures are baked for 20 hours at 150 deg. C.

When removed from the baking oven, armatures must be cooled before the next operations can be performed. This would normally require from six to eight hours. A cooling rack is used to shorten this time. It consists of a rectangular metal box about one foot in depth made of welded steel plates, as shown in Fig. 10. There are six round holes in the top, a little smaller in diameter than a motor armature. A motor-driven fan forces air into the box and through the ventilating ducts of armatures which are placed on end over the holes. If less than six armatures are to be cooled at once, the unused holes are closed with plate metal covers secured in place with cap screws. This procedure reduces the cooling time to about one-fourth that required without the forced ventilation.

After cooling, the armatures are placed in the armature machine for undercutting and grinding of commutators and for a bar-to-bar test. From the armature machine they are moved to the balancing machine which is centrally located in the shop. There is a storage stand (Fig. 11) adjacent to the balancing machine which is used to hold armatures between operations. It consists

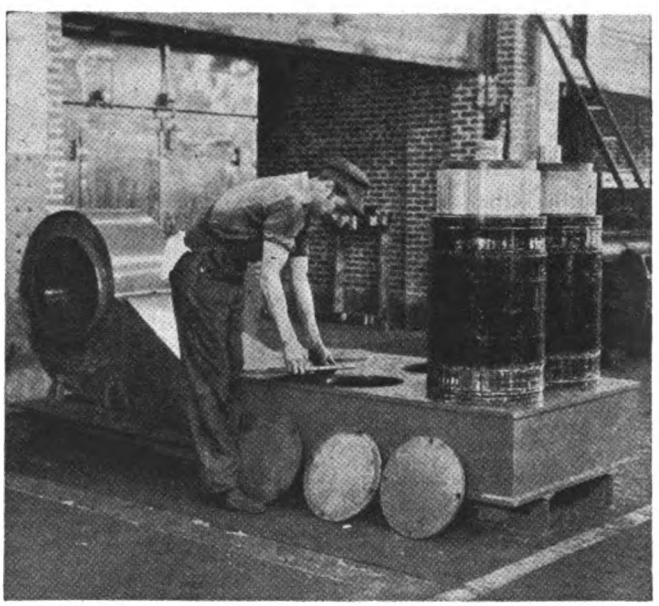


Fig. 10—An armature cooling rack with two armatures in place

of a large flat steel plate elevated about one foot from the floor in which there are a number of holes slightly larger than the diameter of an armature shaft. Armatures are placed commutator-end up on the stand with the shaft extending down through the hole in the plate, an arrangement which takes much less space than stands for supporting them horizontally.

A preliminary balance is obtained on the balancing machine by using wads of modeling clay for balancing weights. After the proper location and amount of weight

Mechanical Assembly Report

Motor Serial No. ..... Job. No. .....
Type or Model No. ..... Manufacturer .....
Assemble Armature No. ..... Pinion No. .....
Job completed (Date) ..... Shipped to .....

Inspection of Armature Bearings and Housings

Clean both bearings with 50-50 solution of gasoline and carbon tetrachloride .....
Inspect bearing rollers and races for wear, pits, scratches and heat .....
Condition of brass roller cage and rivets C.E. .....
P.E. .....
Internal bearing clearance (Not mounted) C.E. .....
P.E. .....
Diameter of outer bearing race C.E. .....
P.E. .....
Diameter of inner bearing race C.E. (Outside) .....
..... (Inside) .....
Diameter of inner bearing race P.E. (Outside) .....
..... (Inside) .....
Condition of C.E. thrust collar .....
Renewed ..... Thickness .....
Condition of oil slingers C.E. ..... P.E. .....
Renewed C.E. ..... P.E. .....
Are bearings to be used new or same C.E. .....
..... P.E. .....
Clean bearing housings and caps, inspect for defect, polish machine fits and paint
Important Note—Polish machine fits with wire brush, do not use abrasive.
Diameter of bearing housing bore C.E. ..... P.E. .....
Signed ..... Date .....

Armature Bearing Assembly

Clean armature shaft, grease sealing grooves and remove all burrs .....
Diameter of shaft (At inner bearing race fit):
C.E. ..... P.E. .....
Diameter of inner bearing race (After assembly):
C.E. ..... P.E. .....
Internal bearing clearance (After assembly):
C.E. ..... P.E. .....
Clean bearing housing fit on frame and remove burrs:
C.E. ..... P.E. .....
Dial indicate bearings C.E. ..... Inch P.E. .....Inch
Apply thrust collar and lock in position .....
Amount of end play ..... Inch
Important—Move armature to limit of lateral several times before checking end play.
Amount of grease applied to bearings:
C.E. .....Ounces P.E. .....Ounces
Prime grease tubes C.E. and P.E. .....
Were grease tubes renewed C.E. ..... P.E. .....
Signed ..... Date .....

Final Assembly and Tests

Bearing test run ..... R.P.M. .....Hours
Reverse ..... R.P.M. .....Hours
Temperature C.E. (Start) ..... F. (Max.) .....F.
(Final) .....F. (Not to exceed 140)
Temperature P.E. (Start) .....F. (Max.) .....F.
(Final) .....F. (Not to exceed 120)
Important Note—Left shaft cool to room temperature before applying pinion.
Date of pinion ..... Number of teeth .....
Does pinion Magnaflux O.K. .....
Is pinion new, same, or from another motor..... Wear.....
Advance reading of pinion (Hot) ..... Heated to .....Deg. F. Time required .....
Advance reading of pinion (Cold)..... (1).....
(2)..... (3)..... Room temp. .....
Final advance of pinion.... Was pinion lapped to shaft....
Are all baffle plates and screens in place.....
Tap out air duct bolt holes .....
Wear or gear case supports:
(Motor frame) .....Inches (Axle cap) .....Inches
Are all nuts for suspension cap bolts welded in place.....
Check wear on nose suspension wear places.....
Inches renewed .....
Clean and apply axle caps (Serial No.).....
With .....Shims
Have axle caps been checked for cracks.....
Tighten axle cap drain plugs .....
Check waste holding plates and springs and apply new felts on all covers .....
Cover all screens and openings with paper, paint motor and apply lubrication tags .....
Signed ..... Date .....
Serial No. ..... Report No. .....

has been determined, permanent weights are applied. On the back-end of the armature these consist of split weights attached with set screws and on the commutator end they are solid pieces tack welded in place. In making the commutator-end weight, due allowance is made for the weight of the added weld metal. High-speed armatures are balanced to within ¼ oz. at the periphery.

After balancing, the armature is given a light coat of air-drying varnish. The Vee ring and commutator rise are painted with DuPont, Flintlfex Red. The armatu is then Meggered and given a high potential test; t bearings applied and the armature assembled in t frame. When the motor is disassembled, bearings a bearing parts are removed and thoroughly cleaned wi a mixture of gasoline and carbon tetrachloride and i mediately dipped in light motor oil. Housings and ca are cleaned with an Oakite solution. The correct amou of grease is added after the bearing is assembled.

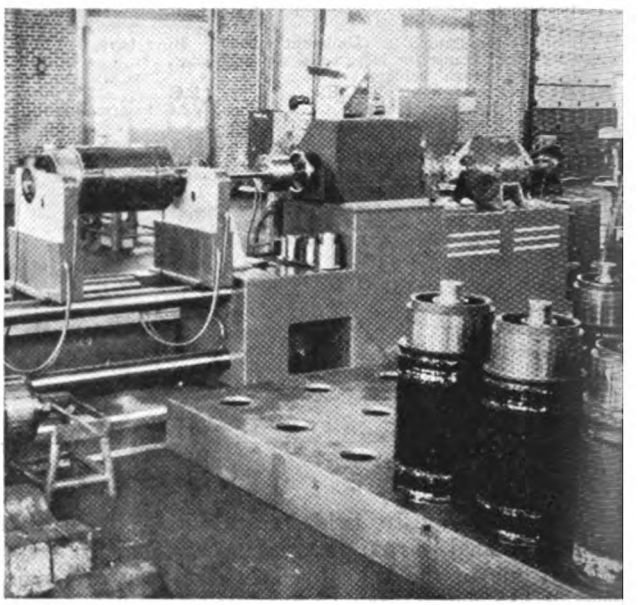


Fig. 11—The balancing machine—The armature storage rack f storing armatures vertically is shown in the foreground

A run-in test at 1,500- to 1,800-r.p.m. is made befo the motor is shipped or installed. Bearing temperatur are checked, brushes run-in and bearings checked f proper operation. A motor-generator set consisting of 125-volt, 400-amp. separately excited generator is use

(*Continued on page 270*)

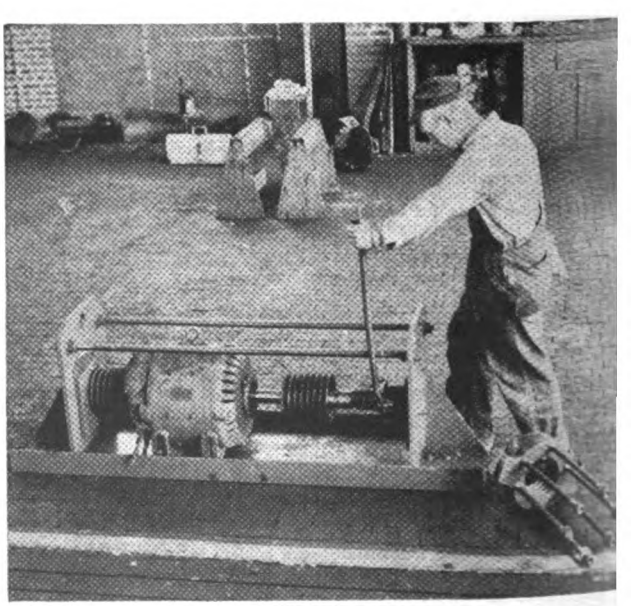


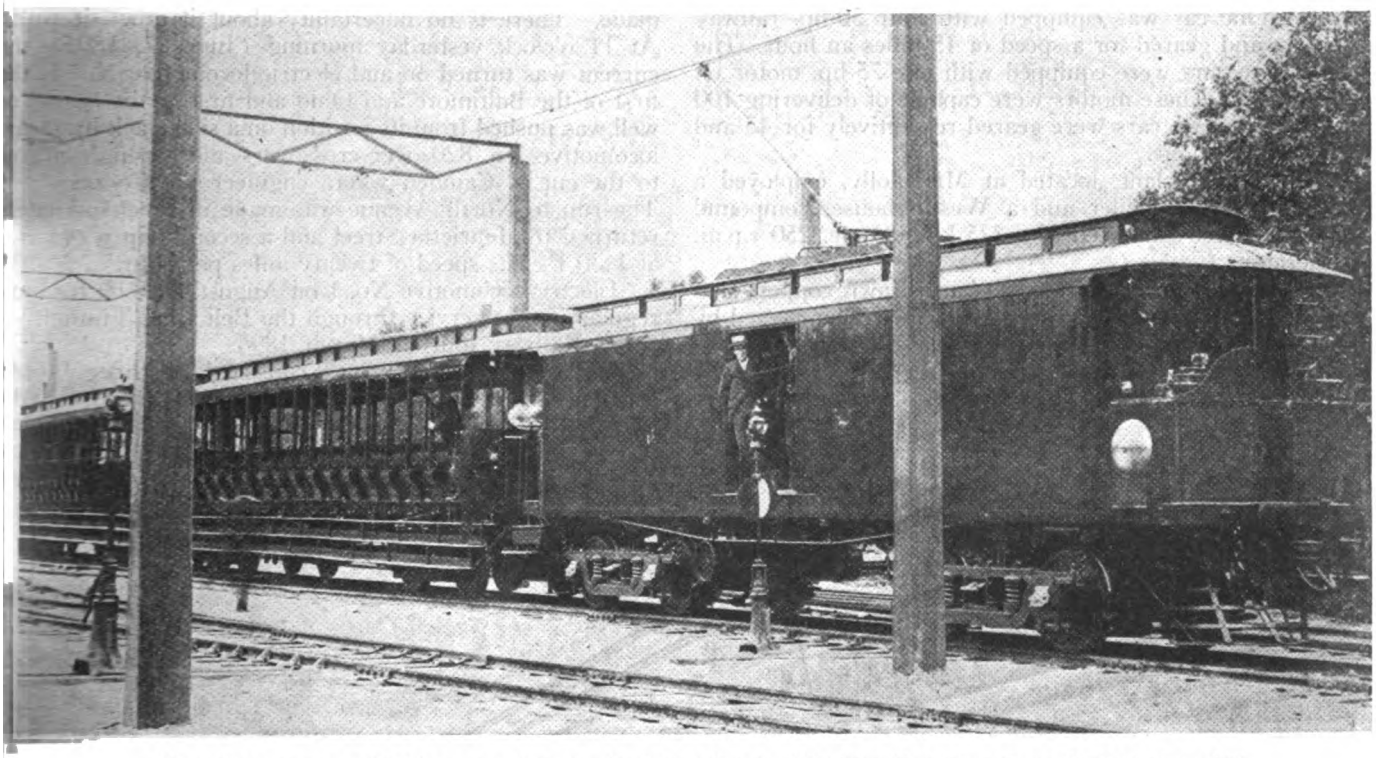
Fig. 12—Frame for applying and puller for removing Vee pulleys o auxiliary-generators

Electrification 50 Years Old

Three railroads replaced steam locomotives with electric motive power in 1895

ELECTRIC traction celebrates a half century of operation this year. Fifty years ago, in 1895, three railroads, the New York, New Haven & Hartford, the Baltimore & Ohio and the Pennsylvania, replaced steam with electric power, credit for "famous firsts" being claimed for two of them on different counts.

The Boston Post in an article appearing June 28, 1895, under the title "Fate of Steam" states, "The use of electricity as a motive power in place of steam will begin for regular service on the Nantasket branch of the New York, New Haven & Hartford railroad today. The event is one in which the officials and employees of that great corporation as well as the General Electric Company, which has had the fitting of the line to be operated with the necessary electric equipment, express the deepest interest, it being regarded as a pioneer experiment to test the value of a new power as compared with the one relied upon so long. Railroad men and electricians throughout the world are also giving it close attention, claiming the result will go beyond anything yet done to determine the practical worth of electricity as a substitute for steam on broad-gauge roads."



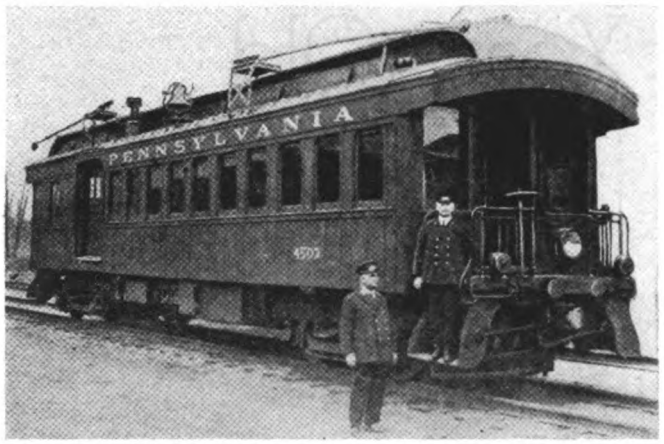
Motor baggage car and trailers as used on the Nantasket Branch of the New York, New Haven & Hartford in 1895

The rolling stock on the Nantasket branch consisted of ten motor cars, six open and four closed and a number of trailers. Each motor car weighed 60,000 lb. and was designed to handle three or four trailers. Power was supplied from a power plant installed for this purpose which was equipped with two tandem compound Greene engines operating at 110 r.p.m. and rated at 1,420 hp. each. The generators were rated 500 kw. each and the station voltage was nominally 700 volts.

The original contact system consisted of an overhead 330,030 c. m. wire of figure-eight section supported by wood poles and double brackets, the distance between the centers of the two tracks being 15 ft. The poles which were of sawed, hard pine were the only insulation between the wires and the ground. The overhead wire was later replaced by a third rail.

The original Nantasket line was later extended and from this beginning, a number of applications were made leading up to the present 11,000-volt a. c. electrification between New York and New Haven, Conn., employing locomotives capable of exerting up to 9,000 hp. Historical facts concerning the early developments are ably presented in a paper by Sidney Withington, electrical engineer, the New York, New Haven & Hartford, appearing in Bulletin No. 26, published October, 1931, by the Railway and Locomotive Historical Society, Chicago, Illinois and Boston, Mass.

Also in 1895, on July 22, the Pennsylvania electrified its Mt. Holly Branch consisting of eight miles of double track with overhead contact system from Mt. Holly, N. J. to East Burlington, on the main line from New York to Camden, N. J.



One of the first electric motor cars used on the Mt. Holly Branch of the Pennsylvania in 1895

The electric motive power consisted of three combination baggage-and-passenger motor cars each capable of drawing a standard P. R. R. coach at a speed of from 45 to 60 miles an hour. The motors were built and installed by the Westinghouse Electric & Manufacturing Company. One car was equipped with four 50-hp. railway motors and geared for a speed of 45 miles an hour. The other two cars were equipped with one 75-hp. motor on each truck. These motors were capable of delivering 100 hp. and the two cars were geared respectively for 45 and 60 miles an hour.

The power plant, located at Mt. Holly, employed a 300-hp. Climax boiler and a Westinghouse, compound engine, direct connected to a 225 kw., 8-pole, 250 r.p.m. generator.

The trolley wire was No. 00 hard-drawn copper, suspended 22 ft. above the track by span wires supported by chestnut poles on each side of the track. There were two 500,000 c. m. feeders, one running the full length of the line and the other about six miles. Rail joints were bonded and two supplementary wires alongside each rail were used for the return circuit.

There are now 671 route miles and 2,231 miles of track in the Pennsylvania's 11,000-volt a. c. Philadelphia, Pa.-Harrisburg-Washington, D. C.-New York electrified lines and the rolling stock consists of some 300 electric locomotives, 385 multiple-unit cars and 47 trailers.

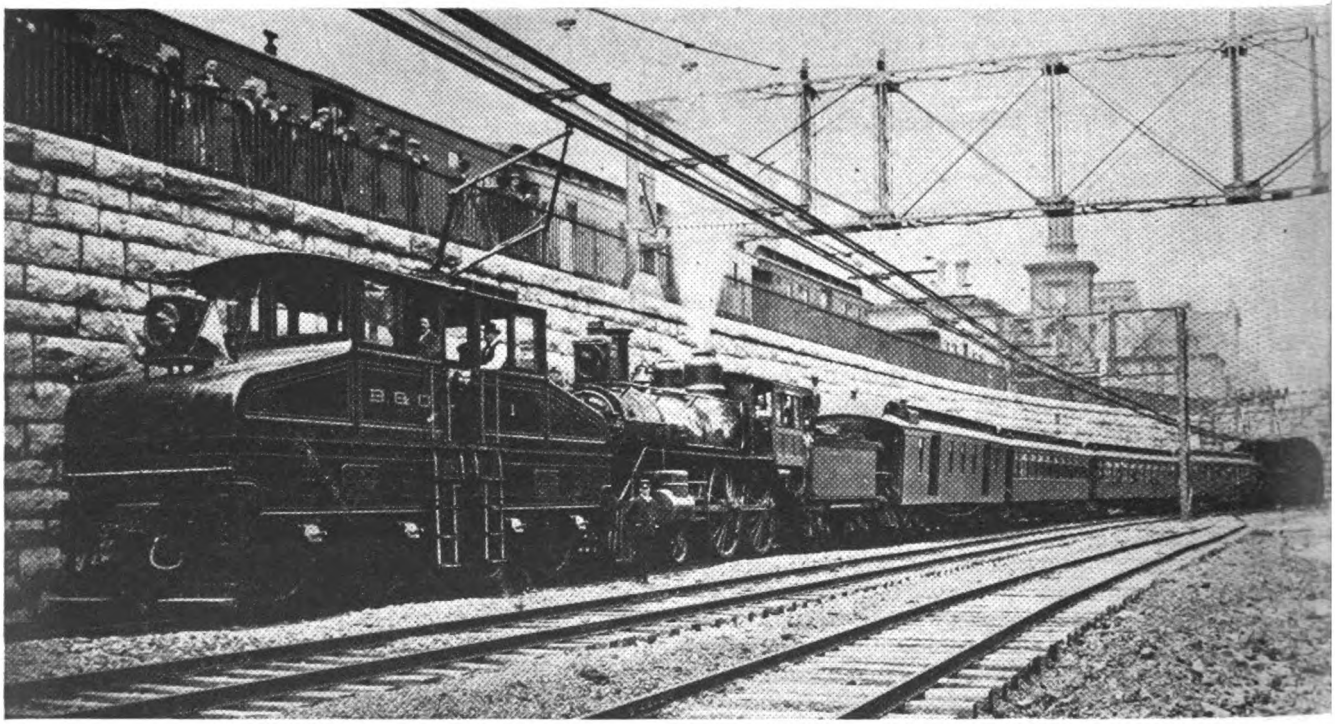
The Baltimore & Ohio which also electrified a steam railroad in 1895 bears the distinction of being the first railroad to use electric locomotives in trunk line service. That portion of the Baltimore & Ohio which was electrified and which is still in operation lies within the city limits of Baltimore and is a part of the so-called Belt-Line, extending from Camden Station on the west to Waverly interlocking tower on the east, a distance of 3.75 miles.

There are eight tunnels in this zone, the longest being 7,300 ft. The tunnel contains two tracks and a part of the line outside of the tunnels is four-track. The average grade is 0.9 per cent and the ruling grade is 1.5 per cent. The electric locomotives are used to haul trains including the steam locomotive eastbound up the grade and return light down grade, the steam locomotives handling the trains in this direction.

The Baltimore Sun of Friday, June 28, 1895, states: "Yesterday, an informal test of this 100-ton machine was made. There is no uncertainty about it now—it pulls. At 11 o'clock yesterday morning (June 27, 1895) the current was turned on and electric locomotive No. 1, the first of the Baltimore and Ohio and first of the world as well was pushed from its position on a side track by steam locomotive No. 820 over crossovers and through curves to the cut at Camden where engineer W. Cooper. . . . The run to North Avenue was made in seven minutes; returned to Henrietta Street and a second trip was made at 1:30 P. M.; speed of twenty miles per hour."

"Electric locomotive No. 1 on August 4, 1895, took up regular freight service through the Belt Line Tunnel."—Street Railway Journal, March, 1896.

The original rolling stock consisted of three 96-ton gearless locomotives. The armatures were mounted di-



Electric locomotive No. 1, built in 1895 pulling a train with its steam locomotive out of the Baltimore & Ohio tunnel in Baltimore

rectly on the main driving axle, the connection to the driving wheels being made through a spider and rubber driving cushions.

Power was supplied directly from a power plant built for that purpose and equipped with five, 500-kw., 700-volt, d. c generators direct-connected to tandem compound, non-condensing Corliss engines.

The original contact system was overhead and employed two Z-bars so arranged as to form a box-like structure with a slot at the bottom. The collector shoe which slid in this slot was attached to the locomotive by a pantograph. Outside the tunnels the Z-bars were supported from towers by catenary construction and in the tunnels by direct hangers. In 1908 the overhead conductors were replaced by a third-rail system. The installation, with newer locomotives, is still in operation.

Steam railroad electrification was antedated several years by electric street railways. The first of these was the Sprague installation in Richmond, Va., early in 1888. Street railways also initiated the use of electric locomotives, the first employed in regular service in the United States being the freight unit installed in May, 1888 on the Ansonia Derby and Birmingham Electric Line. The motive power for this line consisted of three passenger cars

Edison's electric locomotive and experimental track at Menlo Park in 1880

and one locomotive built by the Van Depole Electric Manufacturing Company.

It was 65 years ago, in 1880, that Thomas A. Edison laid a mile of track of 3½ ft. gauge at Menlo Park, N. J., over which he ran cars drawn by an electric locomotive, consisting of a four-wheel iron track on which was mounted a 75-amp., 110-volt motor. The two running rails delivered the current to the locomotive, each wheel having a metal rim and a wood center. A three-legged spider connected each wheel rim to a brass knob from which current was collected by brushes for connections to the motor. A maximum speed of 42 miles an hour was attained.

Following this initial development, a number of electric locomotives were tried. These included the Daft engine "Ampere" on a 12-mile section of the Saratoga, Mt. McGregor and Lake George in 1883, the Daft, "Benjamin Franklin" operating on the New York Ninth Avenue elevated between 14th and 50th Streets in 1885, the Field locomotive tried on the Second Avenue Elevated in New York in 1888, the gearless locomotive built by the Thompson-Houston Company, exhibited at the Chicago World's Fair in 1893 and used in the streets of New Haven, Conn., in 1896 by the Manufacturers Railroad.

Railroad Radio Channels

The Federal Communications Commission on May 17, announced its final frequency allocations to the non-governmental radio services in the portion of the spectrum between 25 and 30,000 megacycles with the exception of the 44 to 108 megacycle region of the spectrum, which is left unassigned at this time pending the outcome of measurements and tests of FM transmission during the coming summer. Railroads have been assigned 60 clear channels in the 152-162 mc. range. A summary of allocations made in the 25-30,000 mc. range is shown below.

Channel Assignments between 25 Mc. and 162 Mc. to Non-Governmental Services

	January 15, 1945 Proposed report			Draft final report		
Service	Non-sharing	Sharing*	Total	Non-sharing	Sharing	Total
Police	122	0	122	132	0	132
Fire	35	0	35	39	0	39
Provisional	0	26[1]	26	0	36[2]	36
Power, petroleum, etc.	21	0	21	31	0	31
General highway mobile	24	0	24	40	0	40
Marine mobile	0	16[3]	16	8	15[4]	23
Special emergency	10	0	10	6	10[5]	16
Urban transit	0	10[5a]	10	0	17[6]	17
Urban mobile	0	7[7]	7	24	0	24
Forestry and Conservation	23	37[8]	60	25	34[9]	59
Aeronautical (flying school and flight test)	0	4[10]	4	7	0	7
Railroads	33	0	33	60	0	60
Geophysical	0	35[11]	35	0	49[12]	49
Relay Press	0	26[13]	26	0	10[14]	10
Relay broadcast	0	26[15]	26	0	36[16]	36
Motion Picture	0	26[17]	26	0	18[18]	18
General experimental	30	4[19]	34	0	26[20]	26
Rural subscriber telephone	0	0	0	0	24[21]	24
Total	298	217	515	372	275	647

* The television channels subject to sharing are not shown in this table.
[1] Shared with motion picture, relay press, relay broadcast and geophysical.
[2] 21 shared with general experimental, 10 shared with special emergency, and 5 shared with urban transit and general experimental.
[3] 9 shared with geophysical, 7 shared with forestry, conservation and urban mobile.
[4] 9 shared with geophysical, 6 shared with forestry and conservation.
[5] Shared with provisional.
[5a] Shared with forestry and conservation.
[6] 12 shared with forestry and conservation, and 5 shared with provisional and experimental.
[7] Shared with forestry and conservation and marine mobile.
[8] 10 shared with urban transit, 20 shared on secondary basis with fire, 7 shared with marine mobile and urban mobile.
[9] 6 shared with maritime mobile, 12 shared with urban transit, 4 shared with relay press and geophysical, and 12 shared with relay broadcast, motion picture and geophysical.
[10] Shared with general experimental on temporary basis.
[11] 26 shared with provisional, motion picture, relay press and relay broadcast, 9 shared with maritime mobile.
[12] 24 shared with relay broadcast; 9 shared with maritime mobile; 4 shared with relay press, forestry and conservation; 12 shared with relay broadcast, motion picture, forestry and conservation.
[13] Shared with provisional, motion picture, relay broadcast and geophysical.
[14] 6 shared with motion picture, 4 shared with forestry, conservation and geophysical.
[15] Shared with provisional, motion picture, relay press and geophysical.
[16] 24 shared with geophysical, 12 shared with motion picture, geophysical, forestry and conservation.
[17] Shared with provisional, relay press, relay broadcast and geophysical.
[18] 6 shared with relay press, 12 shared with relay broadcast, geophysical, forestry and conservation.
[19] 4 to be used temporarily by flying schools.
[20] 21 shared with provisional and 5 shared with urban transit and provisional.
[21] Shared with urban mobile and short distance toll telephone circuits.

The allocations in the 152-162 mc. section of the spectrum are made on the basis of an average channel width of 60 kc. as follows:

Class of station	No. of channels
Police	36
Fire	12
Provisional and experimental	2
Relay press (forestry-conservation, geophysical)	4
Power, petroleum, etc.*	6
Maritime mobile	8
Urban mobile** (rural subscriber telephone, short distance toll telephone)	24
Relay broadcast (motion picture, geophysical, forestry-conservation)	12
Provisional and experimental	2
Railroads	60

* Other classes of stations rendering similar radio services.
** May provide radio communication service to all types of mobile units such as marine, land vehicles, aircraft, etc. Pending final determination of the best method of operation of this service these channels will be assigned on an experimental basis—12 for development on a common carrier basis, 4 for trucks and 4 for buses, except in those cases where it is shown that a different distribution is more desirable.

Services now operating between 156 and 162 mc. may continue temporarily on a non-interfering basis in the 152 to 162 mc. band.

In addition, provision may be made in the 44-108 and 186-216 mc. portions of the spectrum for the operation of non-governmental fixed and mobile services (such as, police control and relay circuits, point-to-point, marine control circuits, forestry fixed circuits, rural telephone, broadcast studio to transmitter links, railroad, terminal and yard operations) upon proper showing of need and that these channels may be shared on a mutually non-interfering basis.

Electric Shop for Diesels

(*Continued from page 266*)

for making initial bearing tests, for run-in tests and for charging batteries. Its capacity is sufficient for operating four traction motors at one time.

If the overhauled motor is to be shipped, all openings are sealed with paper held in place with tape.

Among the numerous devices developed in the shop for facilitating the work being done are two which deserve special mention. Two of these, shown in Fig. 12, are used for applying and removing multiple Vee pulleys used on auxiliary generators. The welded framework shown serves for applying the pulley. It is long enough to include the machine, a pulley and the hydraulic jack used to press the pulley on the shaft. The end plates are stiffened at the center by triangular welded brackets

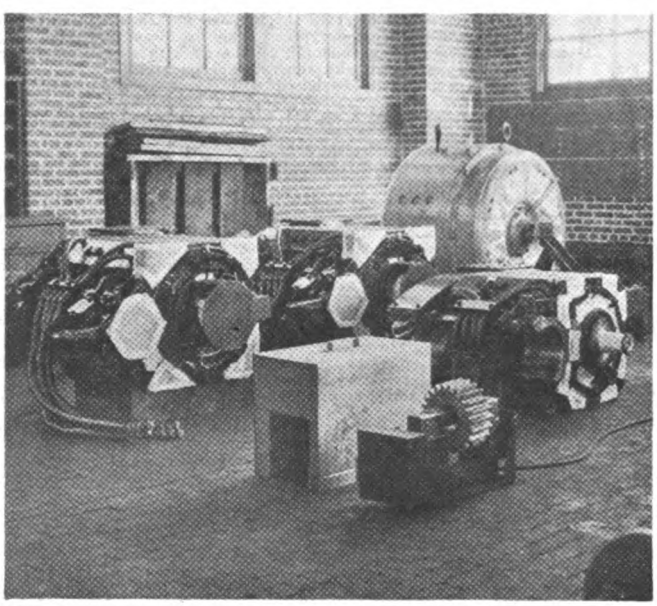


Fig. 13—Motors with all openings covered with paper and tape ready for shipment to outlying points—In the foreground is shown an induction-type pinion heater with a cover for reducing the time of heating

and the upper edges of the plates are connected by threaded rods. It is necessary to remove one of these rods to place the generator in the frame, but this is preferable to making the frame larger, since it would then have to be much heavier to withstand the required pressures.

Multiple Vee pulleys like those shown can be removed with a puller which acts between the inside of the pulley and the end of the shaft, but such a puller often breaks the inside pulley flange. This difficulty is overcome by means of the device shown on the floor at the right. It consists of a split two-part form having internal grooves which exactly fit the grooves of the pulley. The two parts of the form are tightened onto the pulley by two bolts and the six threaded rods hold a pressure plate at the end opposite the grooved form. A hydraulic jack placed between the pressure plate and the end of the shaft is then used to remove the pulley. This is accomplished easily with no damage to the pulley.

In the foreground of Fig 13, is shown an induction type pinion heater for applying pinions to traction motor shafts. The unique feature of this heater is the metal cover shown behind the heater. This is placed over the heater when a pinion is being heated and serves effectively to conserve heat, thus reducing the amount of power required and shortening the time required t bring the pinion to the proper temperature. Pinions ar lapped to the shafts and the fit is relieved at one end t allow for advancing the pinion along the shaft when it i applied.

Armature Report

Serial No. ..... Type..... Manufacturer.....
Commutator Serial No. ..... Date of commutator.....
Rec'd in shop on Job. No. .... Motor No. .... Date.....
Out of shop on Job No. ..... Motor No. .... Date.....
Mileage this application..... Accumulated mileage.....
Note below any unusual conditions such as possible overload or overheating, solder thrown out, coil leads loose in riser, commutator bars burnt shaft B.O. .....
Is amature new, rewound at Atlanta Motor Shop or service .....
Megger reading of armature at disassembly (before cleaning) .....
Megger reading of wire bands at disassembly (before cleaning) .....
Does amature shaft Magna-flux O.K. P.E..... C.E.....
Shaft renewed..... Stamped with Ser. No. .....
Spec. stamping .....
Condition of wire bands C.E. ..... P.E. .....
Band clips C.E. ..... P.E. .....
Apply new wire bands P.E. lower at.....lbs. tension —size wire used .....
Apply new wire bands P.E. upper at.....lbs. tension —size wire used.....
Apply new wire bands C.E. lower at.....lbs. tension —size wire used.....
Apply new wire bands C.E. upper at.....lbs. tension —size wire used.....
Are bands properly soldered and clips in place C.E...P.E...
Was wire band insulation renewed .....
Condition of P.E. coil supports .....
Are slot wedges tight.... General condition of core.....
Condition of sring band..... Was string band renewed....
Clean armature and preheat,.....Hours at.....Degrees C.
Chart No. .....
Impregnate armature and bake....Hours at.....Degrees C.
Chart No. .....
Clean riser, "V" ring and string band and paint red.....
Clean P.E. coil support and spray armature with air drying varnish.....
Tighten commutator bolts at.....Pounds (average)
Were bolts renewed.....
Are commutator bolts locked or welded in place.....
Which method.....
Dial indicate commutator (before machining) Taper.....
..... Out of round.....
Machine commutator (hone, grind or turn).....
Bevel end of bars.....
Diameter of commutator (after machining).....
Dial indicate shaft .....
Note below any special machine work done on armature or shaft .....
Dial indicate commutator (after machining) Taper.....
..... Out of round.....
Undercut mica.....X.....and remove burrs on commutator bars.....

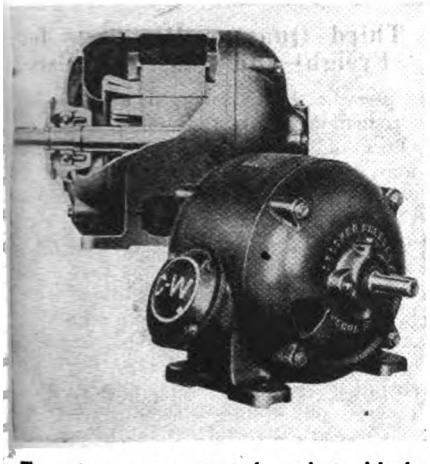
Initial unbalance	C.E.	Oz. at	Degrees
	P.E.	Oz. at	Degrees
Correction made	C.E.	Oz. at	Degrees
	P.E.	Oz. at	Degrees
Final unbalance	C.E.	Oz. at	Degrees
	P.E.	Oz. at	Degrees

Bar to bar test in michroms—Minimum.....
Maximum..... Average.....
Megger reading before high potential test-armature.....
..... Bands.....
Apply high potential test of.....Volts A.C. for.....seconds to Armature
Apply high potential test of.....Volts A.C. for.....seconds to wire bands
Give armature final inspection, apply identification tag.....
.....
Note 1. .....
Note 2. .....
Note 3. .....
Note 4. .....
Report No. ..... Signed.....
Inspector
Serial No. ..... Date.....

NEW DEVICES

Protected Type Motor

Motors combining the surplus capacity of the conventional open motor, with protection against dripping liquid, falling metal chips and other foreign matter, have been developed by the Crocker-Wheeler division of Joshua Hendy Iron Works, Ampere, N. J. Rated 40 deg. C. rise, full-load, continuous duty, with a 15 per cent service factor, the motors provide added protection at open motor prices. At present these motors are available in sizes up to and including the 284 frame. Mounting dimensions conform to the standards of NEMA.



The motors are protected against dripping liquid, metal chips and other foreign matter

There are no openings in the frame or shields above the horizontal center line. This, together with the shielded construction of the ventilating openings, makes the motors suitable for machine-tool and similar applications where other types of enclosures have been required in the past.

Centrifugal seals permit use of softer grease for better lubrication and longer bearing life. Rotors, bars, fans and end rings are cast from aluminum alloy. Frames are of heavy cast construction, coils are protected by vinyl acetal insulation, and front and rear shields are interchangeable.

Blackhall Car Washer

With a background of experience in the installation and operation of 150 Blackhall bus washers for cleaning transit company buses and highway coaches, the Ross and White Company, Chicago, has developed an application of this type of equipment for cleaning railroad passenger train cars. One has recently been installed for the Baltimore & Ohio and the Alton at the West Fifteenth and Loomis Streets track elevation, Chicago.

The Blackhall patent car washer is a stationary machine, bolted securely to concrete foundations. It consists of two H-beam columns on which are supported three brushes on each side—two body brushes for the cars and one window brush, revolving in opposite directions. Thus, the windows receive cleaning from three brushes on each side. A fan spray with special nozzles wets down the dirt on the car. Then the three brushes, which have water supplied through bell nozzles into the brushes behind the water guards, scrub the dirt off the car. A final cleansing spray washes off the muddy water, leaving the car thoroughly clean.

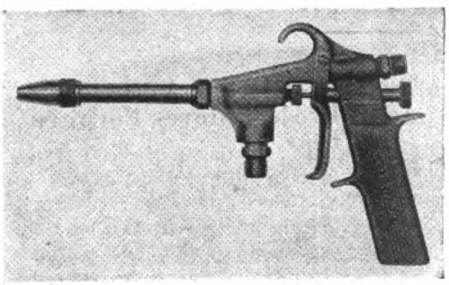
Located 145 ft. from the washer is a small-nozzle air-operated acid spray, used, when the amount of dirt necessitates this treatment, to supply a certain amount of oxalic acid or cleaner to the sides of the car, without dripping or loss of acid. This works on the dirt while each car is moving a distance of 145 ft. to the washer. When acid is applied, the entrance fan spray is shut off by a valve and the first large body brush rubs the acid onto the surface. The next two brushes (the window and the second side brush) stir this up into a soapy foam which is washed off by a final clean spray.

One of the features of the Blackhall car washer is its use of the Fullergript brush strip, held in split aluminum cores or hubs on the brush shafts, thus facilitating quick renewal when necessary. The large body brushes on each side of the washer are driven by individual waterproof General Electric, 3-hp. motors, with Allis-Chalmers Tex-Rope drives and the small window brushes, by 2-hp. motors.

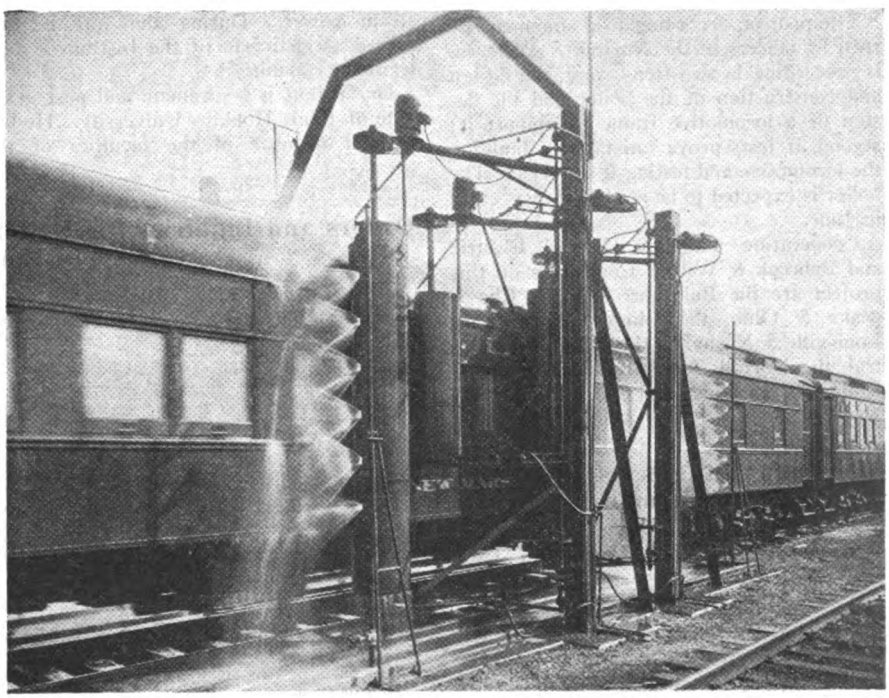
Cars are run through the washer slowly to get the best washing job. The time required is about 1½ minutes per car. An average of 115 cars are being washed a day, with the Capitol Limited of the Baltimore & Ohio, consisting of 13 passenger coaches, each 80 ft. long, being washed every morning in 30 min.

Spray Gun for Cleaning Operations

The DeVilbiss Company, Toledo, Ohio, has announced a new pressure-feed spray gun especially designed for industrial degreasing and cleaning operations on castings, forgings, sheet metal, etc. Operated from a pressure feed tank, the gun handles all kinds of commercial solvents and cleaners, producing a heavy, driving, but well atomized spray that speedily removes dirt and grease. Light in weight and shaped to fit the hand comfortably, this new gun has a two-finger, easy-to-pull trigger designed to reduce hand fatigue. When the trigger is pulled only part way back, air alone is emitted from the nozzle, permitting the gun to be used for both dusting and spraying.



Spray gun intended for use with solvents and other liquid cleaners



Blackhall patent car washer

NEWS

Norfolk & Western Movie Stars Locomotives

"THE Modern Coal-Burning Steam Locomotive," is the title of a new motion picture produced by the photographic staff of the Norfolk & Western which was recently released for showing before interested audiences. Running time of the film is about 25 minutes and it is available in 16 mm. Kodachrome prints. In it, Del Sharbutt, nationally known radio announcer, tells the story of modern coal-burning steam locomotives as they are built in the railway's shops and maintained and operated over the N. & W. lines. Both the Class J and Class A engines appear in the picture and their low first cost, availability, versatility and economical operation is either pictured or orally emphasized.

Turbine-Electric Locomotive Joint Project Moves Forward

PROGRESS is reported in the cooperative development of a steam-turbine electric locomotive, in which the General Electric Company and the Babcock & Wilcox Company are participating with nine railroads, which has been under way since November 7, 1944. Using pulverized coal as a fuel, steam will be generated at 650 lb. in a high-pressure boiler and will develop 6,900 shaft horsepower in the non-condensing steam turbine which will operate the electric generator. It is anticipated that this fuel will produce a drawbar horsepower hour for two-thirds the fuel required in the most efficient conventional types of steam locomotives now in service.

The project, according to a statement issued by officers of the Norfolk & Western, is proceeding in two steps: first, the design and construction of the boiler and the design of a locomotive frame to support it; second, if tests prove satisfactory, building the locomotive and testing it in service. The boiler is expected to be ready for tests early in June.

Cooperating with the General Electric and Babcock & Wilcox Companies on this project are the Baltimore & Ohio, Chesapeake & Ohio, the Illinois Central, the Louisville & Nashville, the New York Central, the Norfolk & Western, the Pennsylvania, the Reading, and the Virginian.

Perlman Resigns as Research Chairman

A. E. PERLMAN, chief engineer of the Denver & Rio Grande Western and chairman, since its inception, of the sub-committee for engineering and mechanical research of the A. A. R. Railroad Committee for the Study of Transportation, has asked Judge R. V. Fletcher, chairman of the "big committee," to relieve him of the sub-committee chairmanship in view of his "heavy load of extra-curricular activities added to his normal duties."

In accepting "with great regret the necessity for this action" on Mr. Perlman's part, Judge Fletcher has expressed his appreciation for the "time and talent which has gone into" the retiring chairman's labors for the sub-committee, and has asked H. R. Clarke, chief engineer of the Burlington, to act as chairman of the sub-committee for the time being—at least until the committee can be called together for a further review of the course to be followed in the completion of its assignment.

Dr. Yellott Heads Locomotive Development Committee

DR. JOHN I. YELLOTT has been appointed to direct the $1,100,000 program of the Locomotive Development Committee consisting of representatives of six railroads, originators of heavy bituminous tonnage, and three bituminous mining companies, which was formulated at a meeting at New York in January as reported on page 88 of the February *Railway Mechanical Engineer*. Bituminous Coal Research, Inc., will handle the research project which is intended to increase the efficiency of the steam locomotive through the use of powdered coal, the development of turbines, and the application of newer steam-power principles.

Dr. Yellott, who will make his headquarters in Baltimore, Md., is now the director of the Institute of Gas Technology of the Illinois Institute of Technology and is the inventor of a method of pulverizing coal through the direct action of moderate steam power. During the war he has served as chairman of the Institute's war-training committee.

Dr. Yellott is a graduate and post graduate of Johns Hopkins University. He has been a member of the faculties of the University of Rochester and Stevens Institute of Technology and has published many technical papers upon subjects related to steam generation and utilization. He is a member of the American Society of Mechanical Engineers, also of the executive committee of its Power division.

Third Quarter Prospects for Freight and Passenger Cars

FOR the third quarter of 1945 the War Production Board has allocated to the Office of Defense Transportation 220,000 tons of carbon steel for freight cars, according to a report made to the Railroad Car Builders Industrial Advisory Committee of the W. P. B. at a recent meeting at which a six-to-five vote was cast for the immediate revocation of General Order L-97s limiting the production and delivery of new freight cars. The report was made by D. W. Odiorne, chief of the Transportation Equipment Division's Motive Power and Rolling Stock Section. Mr. Odiorne also informed the committee that O. D. T. has recently requested W. P. B. to allocate materials immediately for the construction of passenger cars at the rate of 250 a quarter.

Mr. Odiorne's comment on the latter, as reported in a W. P. B. release dated May 15, was that "materials prospects for limited passenger-car building in the third quarter of 1945 were good with the possible exception of stainless steel. However, there may be some difficulty in obtaining components immediately but these should be forthcoming in time to permit delivery of cars to start late in 1945."

Meanwhile, Mr. Odiorne estimated that freight-car production in this year's fourth quarter will be 11,000 cars on the basis of the steel allocated for the third quarter, as noted above. He told the committee that

(Continued on next left-hand page)

Orders and Inquiries for New Equipment Placed Since the Closing of the May Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Long Island	6	600-hp. Diesel-elec.	Electro-Motive
New York Central	5[1]	1,000-hp. Diesel-elec.	Electro-Motive
Pennsylvania	3	600-hp. Diesel-elec.	Electro-Motive
	2	1,000-hp. Diesel-elec.	Electro-Motive
Seaboard Air Line	14	Diesel-elec. pass.	Electro-Motive

LOCOMOTIVE INQUIRIES

Road	No. of locos.	Type of loco.	Builder
New York Central	1[2]	4-4-4-4	
Texas & Pacific	2 or 3	4-4-4-4	

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Missouri Pacific	400[3]	50-ton box	Pullman-Standard
	50	70-ton covered hopper	American Car & Fdry.
Texas & Pacific	50	70-ton covered hopper	American Car & Fdry.
Union Pacific	500	50-ton auto box	

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Richmond, Fredericksburg & Potomac	8	[4]	Edw. G. Budd
Seaboard Air Line	30		
Pennsylvania	10		

[1] In place of five 600-hp. Diesel-electric locomotives originally ordered in 1942, order for which has been cancelled.
[2] Experimental.
[3] 200 for the St. Louis, Brownsville & Mexico; 200 for the International-Great Northern.
[4] To cost approximately $4,500,000. Inquiry reported in the April issue.

Let's replace this picture

THE MIGHTY 7th WAR LOAN

with one like this

How much more effectively, more powerfully
can we speed heart-warming homecomings
if all of us back to the limit
the mighty 7th War Loan, two drives in one,
— if we railroad men give the highball
to all-out bond selling among our employees
— to all-out bond buying by ourselves.

AMCGW

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE, NEW YORK 17, N. Y. • 445 NORTH SACRAMENTO BOULEVARD, CHICAGO 12, ILL.

Organized To Achieve: Uniform Specifications — Uniform Inspection — Uniform Product

4103

production during the last several monhs "has been very disappointing," listing deliveries as follows: January, 4,353 cars; February, 4,024; March, 4,842; and April, 3,495. The carry-over as of May 1 was put at 4,823 cars.

Members of the committee, according to W. P. B., attributed the lag in production to "manpower difficulties, primarily absenteeism and work stoppages." As a result of the lag, the committee was told that W. P. B. Chairman J. A. Krug has appointed a task committee to see what can be done to overcome the difficulties.

Army representatives at the committee meeting were reported to have said that the Army program for freight cars in 1946 would be "very modest"—approximately 98,000 cars including 38,250 now being procured for France.

Budd Plans Complete Range of Passenger Cars

At Philadelphia on May 2 Edward G. Budd, president of the Edward G. Budd Manufacturing Company, announced that the company will resume the manufacture of lightweight stainless steel railway passenger cars as soon as man-power and materials are available and will include among its post-war products, cars for both day and night occupancy, as well as all types of recreational facilities required for the well-balanced, all-purpose consist of a train. The program includes resumption of the reserved seat sleeper coaches, or chair cars, as well as dining, lounge, tavern, observation, and several sleeping car types.

"Our designers have ready for the post-war market a comprehensive range of railway passenger cars which will enable us to offer to the railroads of the country complete train consists for day and night traffic, including recreational and revenue-producing units, all of uniform design," Mr. Budd said.

The company will give special attention, he said, to developing car types designed to provide low-cost bedroom service, in line with its policy of furnishing equipment which would help to attract mass travel to the railroads. "We believe both the railroads and the traveling public can best be served by furnishing commodious coach and luxurious sleeper coach service at coach fares. In addition, we expect there should be a substantial market for sleeping cars which would furnish more luxurious overnight service but still at moderate cost. We expect to use part of our facilities for the manufacture of equipment of this type."

The intensive development of this sort of railroad travel after the war, Mr. Budd expects, will result in maintaining the volume of travel experienced during the war, and thus enforce a great and continued demand for the type of modern, streamlined stainless steel railway cars the Budd company manufactures.

Bureau of Transport Economics Train Performance Data

In a recent issue of its "Monthly Comment on Transportation Statistics," the Bureau of Transport Economics and Statistics, Interstate Commerce Commission, includes an analysis on train performance by kind of locomotive. The figures in this analysis show among other things, that steam locomotives in the first two months of 1945 hauled 92.6 per cent of the total gross ton-miles (excluding locomotives and tenders) as compared with 95.9 per cent in the first two months of 1944. Diesel-electrics hauled 5.6 per cent this year, and 2.2 per cent last year. The Bureau suggests that severe weather in January may have had some influence on the figures, particularly for the East, where "steam operation is high relative to Diesel."

"The average number of gross ton-miles per train-mile (including locomotives and tenders) or gross tons per train in the 1945 period," the statement continues, "was 2,551 for steam locomotive trains as compared with 3,305 for Diesel trains, while the tonnage of locomotives and tenders only was 308 for steam and 381 for Diesel. Per ton of locomotives and tenders the load hauled (cars, contents and cabooses) was 7.28 tons in steam locomotive trains and 7.67 tons in Diesel trains. The average speed of Diesel freight trains in 1945 was 19.4 miles per hour or about 29 per cent greater than that of the steam trains.

"The foregoing figures, of course, are overall averages. Many Class I roads had no Diesels in the freight service in either period and several others only a very few. The averages, therefore, do not reflect like operating conditions and consequently do not measure satisfactorily the relative performance or efficiency of steam and Diesel locomotives. Based on gross ton-miles, including locomotives and tenders, in the first two months of 1945 nearly two-thirds of the total Diesel freight service was in the Western district."

New Strain Gage Demonstrated by Baldwin Southwark

On May 1, 2 and 3 the Baldwin Locomotive Works, Baldwin Southwark Division, held at the Hotel Statler, Washington, D. C., a conference and demonstration of the use of the SR-4 resistance wire strain gages and electrical indicating equipment. Each day's program consisted of two sessions, one in the morning and one in the afternoon. At the morning sessions the application of the strain gage and its equipment was demonstrated, followed by a discussion of the theory of strain-gage measurements, and of the accessory equipment for indicating and recording strain-gage circuits. The afternoon sessions dealt with dynamic and fatigue testing and included discussions of multi-axial strains and the application of electrodynamics to recording, switching, telemetering, analyzing and fatigue testing.

Because of low first cost and the simple method of attaching the gages they can be applied at many locations on a structure or machine and, by the use of suitable switching equipment, the readings from many locations can be quickly scanned and recorded.

For those unable to attend during the day one evening session was held on May 2. Each day's sessions were attended by some 300 persons representing the armed forces, the Maritime Commission, members of the teaching staffs of local colleges and universities, railroad men, and others. A series of similar conferences have been arranged for a number of other cities, some of which have already been held.

Supply Trade Notes

Stromberg-Carlson Company.—*Carl G. Howard* has been appointed railroad sales representative of the Stromberg-Carlson Company, with headquarters in Chicago as heretofore.

◆

Champion Rivet Company. — The Champion Rivet Company of Cleveland, Ohio, and East Chicago, Ind., during the month of April celebrated its fiftieth anniversary.

◆

Bendix Aviation Corporation.—*Arthur C. Omberg* has been appointed chief research engineer and *Dr. Harold Goldberg*, research engineer of the Bendix Radio division of the Bendix Aviation Corporation, Baltimore, Md. Mr. Omberg will be in charge of all Bendix Radio long-term product development and electronic research in radio, radar, and television.

◆

Copperweld Steel Company.—*John J. Healy*, who has been with the Army Air Forces for the past 33 months and holds the rank of captain, has been assigned to inactive duty and has returned to the Copperweld Steel Company as northwest representative. He will serve under the jurisdiction of Copperweld's Chicago office and will cover the states of Minnesota, North and South Dakota, Montana, the upper peninsula of Michigan and the northern portion of Wisconsin—the territory he covered prior to his enlistment.

◆

Scullin Steel Company. — *R. C. Geekie*, assistant to the president in charge of sales, has been elected vice-president in charge of sales of the Scullin Steel Company. *B. L. Norton*, sales agent in New York, has been appointed assistant vice-president, with offices in New York. *F. H. Spenney*, chief mechanical engineer, has been appointed assistant vice-president in charge of engineering.

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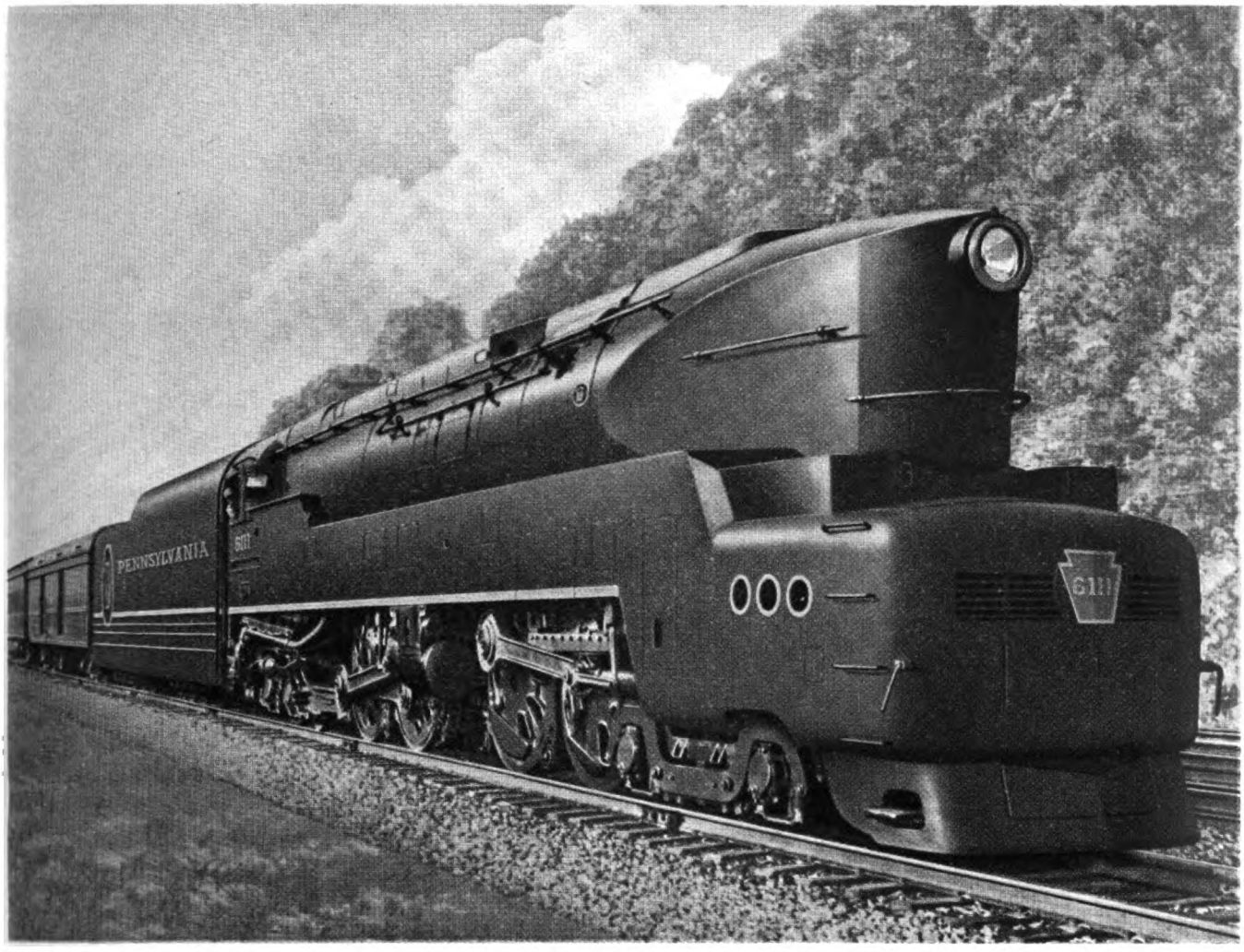
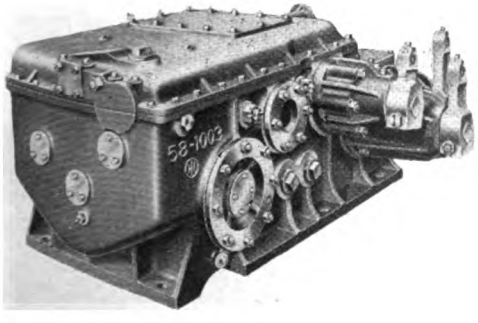


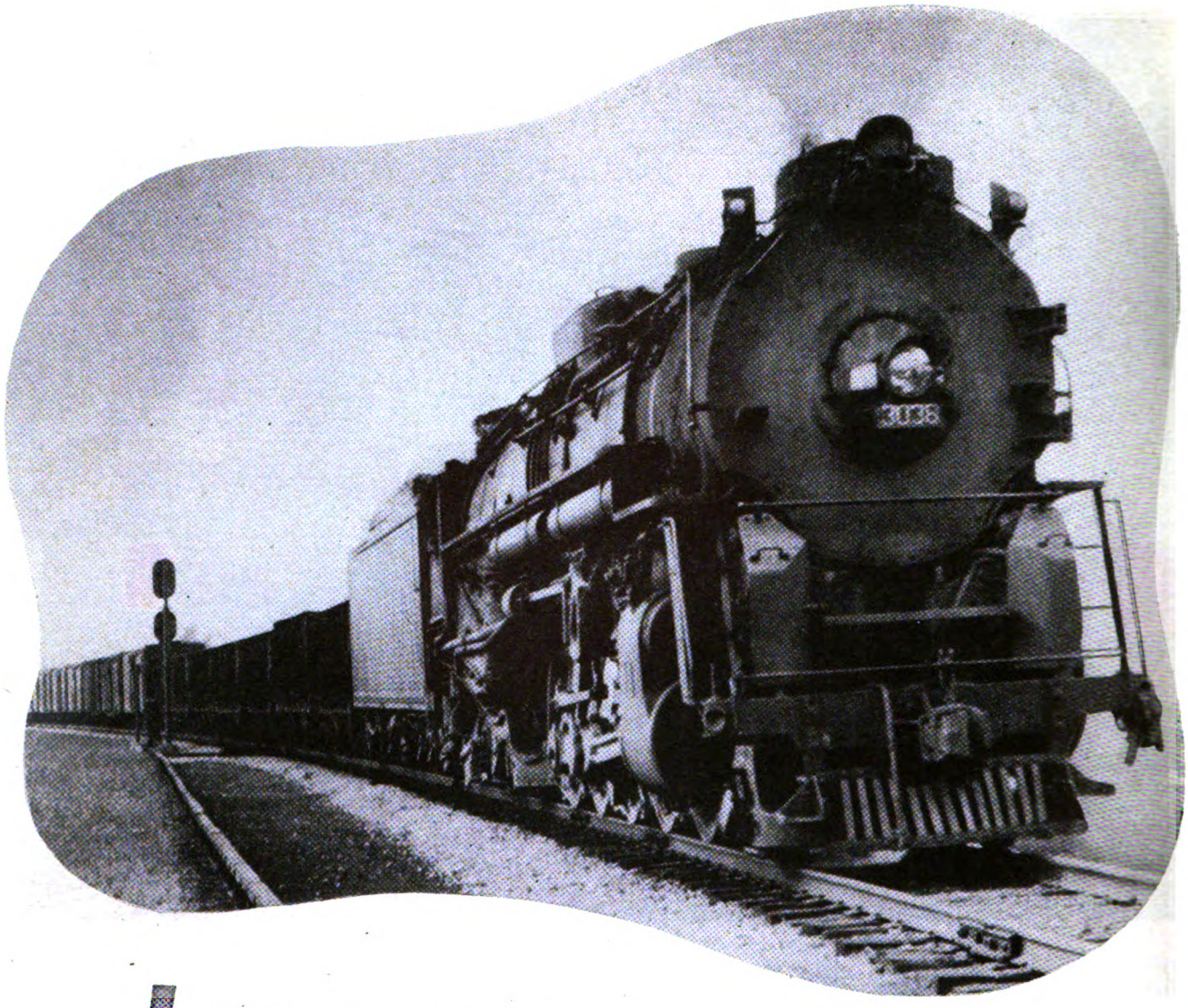
The Pennsylvania Railroad's New Multiple Cylinder Locomotives for Passenger or Freight Service

are equipped with THE FRANKLIN SYSTEM OF STEAM DISTRIBUTION



The Pennsylvania Railroad is to be congratulated on the development of these streamlined giants. These locomotives develop more horsepower at 100 miles per hour than any other engines ever built. Franklin is proud that its System of Steam Distribution is one of the contributions to this achievement.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.
NEW YORK • CHICAGO
In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL



TO *Increase* FREIGHT CAR AVAILABILITY

LIMA Steam Locomotives, by enabling railroads to maintain faster freight schedules, do more than cut down delivery time that may be vital to the war effort.

They also greatly increase freight car availability by reducing the hours between loading point and destination.

Although the need of getting maximum service from every freight car is spotlighted by wartime emergencies, it always will be a vital factor in successful railroading.

LIMA LOCOMOTIVE WORKS INCORPORATED, LIMA, OHIO

Nothing

CAN REPLACE THE ENGINEMAN'S *EYE!*

Never was it more important for the locomotive crew to watch water glasses and gauge cocks to make certain there is adequate water in the boiler. Nothing can take the place of this everyday operating routine.

But if an emergency involving low water does occur, the locomotive equipped with Security Circulators has additional protection.

Not only do Security Circulators strengthen the firebox structure, but they also insure a positive circulation of water over the center of the crown sheet.

AMERICAN ARCH COMPANY, INC.

NEW YORK · CHICAGO

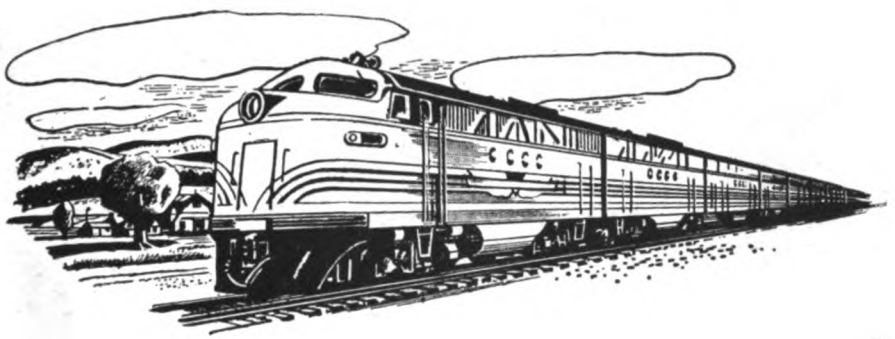
SECURITY CIRCULATOR DIVISION

IT'S A GREAT NEW DAY FOR RAILROADING

ADD SOMETHING NEW

GENERAL MOTORS
LOCOMOTIVES

IT'S A GREAT NEW DAY FOR RAILROADING



One way to meet—and surpass—
various forms of competitive freight
and passenger service after the war
is to *add something new.*

To America's finest railroads, that means
full utilization of Diesel power
in the form of General Motors Diesel
passenger and freight locomotives.

Their impressive records, as well as
their colorful and ultramodern
appearance, certainly capture and hold
the public's imagination.

ON TO FINAL VICTORY ★ BUY MORE WAR BONDS

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION · LA GRANGE, ILL.

TIMKEN ROLLER BEARING COMPANY.—*Tracy V. Buckwalter* has retired as chief engineer and vice-president of the Timken Roller Bearing Company, but will continue in a consulting capacity. *Albert L. Bergstrom* has been elected vice-president of all engineering of the company. *O. J. Horger,* formerly in charge of railway engineering and research, has been appointed chief engineer of the railway division; *C. L. Eastburg,* who has been in active charge of the design of bearings and parts as applied to locomotives, has been appointed assistant chief engineer of the

Tracy V. Buckwalter

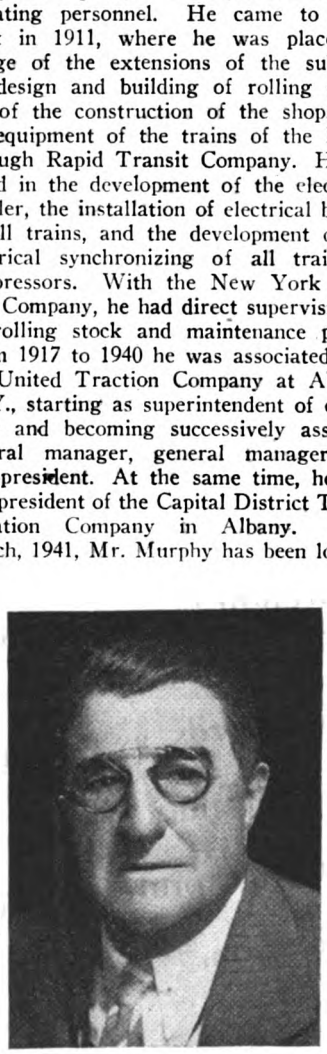
railway division, and *P. C. Paterson,* who has been active in the inspection and procurement of material and in equipment applications, has been appointed manager of the division.

Tracy V. Buckwalter joined the Timken Company in 1916 as chief engineer after 16 years in the Altoona, Pa., shops of the Pennsylvania, where he developed the motor baggage truck bearing his name. He was elected vice-president of Timken in 1925 and thereafter devoted a large part of his time to the company's railroad activities. He developed the application of Timken bearings to passenger- and freight-car journals and for passenger and freight locomotives. Under his direction, the company built a high-speed passenger- and freight locomotive all axle journals of which were equipped with Timken bearings. This locomotive was loaned to many of the railroads and gave immediate stimulus to the application of roller bearings to driving-axle journals. Mr. Buckwalter is the author of the following publications: "Roller-Bearing Service in Locomotive, Passenger and Freight Equipment"; "Locomotive Axle Testing"; "Investigation of Fatigue Strength of Axles, Press-Fits, Surface Rolling and Effect of Size"; "Stress Analysis of Locomotive and Other Large Axles"; "Locomotive Axle and Wheel Research"; and "Steam Locomotive Slipping Tests."

Albert L. Bergstrom is a graduate, with a degree in mechanical engineering, of the Royal Technical Institute in Stockholm, Sweden. He came to this country in 1924, and was appointed designing engineer for the Stearns Conveyor Company of Cleveland, Ohio. He joined the Timken Company as development engineer in 1929 and was given various engineering and development assignments. He was later appointed chief works engineer, and, in 1938, became executive engineer.

◆

PRESSED STEEL CAR COMPANY.—*Ernest Murphy,* vice-president in charge of operations of the Pressed Steel Car Company, has been elected president to succeed *John F. MacEnulty,* who becomes vice-chairman of the board of directors. The sales department continues under the direct jurisdiction of Mr. MacEnulty. *Ernest Murphy* was born in Padiham, England, and received his early education and training in that country. He came to this country in 1909 and worked on type M control electrical difficulties on the Chicago elevated lines. Later in that year he went to Pittsburgh, Pa., where he worked for the Butler, Pittsburgh, Harmony & New Castle Interurban Traction Company as division engineer in charge of construction. After the construction assignment was finished, Mr. Murphy was appointed in charge of operation and the training of operating personnel. He came to New York in 1911, where he was placed in charge of the extensions of the subway, the design and building of rolling stock, and of the construction of the shops and the equipment of the trains of the Interborough Rapid Transit Company. He assisted in the development of the electrical coupler, the installation of electrical brakes on all trains, and the development of the electrical synchronizing of all train air compressors. With the New York Railway Company, he had direct supervision of all rolling stock and maintenance plants. From 1917 to 1940 he was associated with the United Traction Company at Albany, N. Y., starting as superintendent of equipment and becoming successively assistant general manager, general manager and vice-president. At the same time, he also was president of the Capital District Transportation Company in Albany. Since March, 1941, Mr. Murphy has been located



John F. MacEnulty

at the Hegewisch (Chicago) plant of the Pressed Steel Car Company, in charge of the Armored Tank division.

John Forest MacEnulty received his early education in Pittsburgh, Pa. He began his career in the bureau of inspection of the Carnegie Steel Company, Pittsburgh, in 1892 and entered the employ of the Pittsburgh Testing Laboratories in 1895. He joined the Pressed Steel Car Company at its Allegheny plant in February, 1899, as a member of the inspection force. He later became chief inspector and then engineer in charge of construction. He was transferred to New York in 1904 as sales representative, and, in 1907, to Chicago as general superintendent of the Hegewisch plant of the Western Steel Car & Foundry Company, a subsidiary. Mr. MacEnulty was appointed general manager in 1909; returned to New York in 1912 as general sales manager of the

Ernest Murphy

Pressed Steel Car Company and the Western Steel Car & Foundry Company; in 1916 was appointed vice-president in charge of sales, and in December, 1937, was elected president of Pressed Steel.

◆

BUDA COMPANY.—The Buda Company, Harvey, Ill., has opened new sales and service offices at Portland, Me.; Cincinnati, Ohio; Columbia, S. C., and Regina, Sask.

◆

GENERAL AMERICAN TRANSPORTATION CORPORATION.—Sam Laud, executive assistant to the president, has been elected president of the General American Transportation Corporation to succeed *Lester N. Selig,* who has been elected to the newly created position of vice-chairman of the board. *Max Epstein* is chairman of the board. *W. S. Hefferan, Jr.,* formerly secretary of the company, and *Arthur W. Lissauer,* general manager of the process equipment division, have been elected vice-presidents; *Maurice J. Feldman* has been elected secretary, and *Frank E. Selz* has been appointed assistant to the president.

Frank E. Selz was born at Chicago on December 29, 1892, and is a graduate of Yale University. He entered the service of General American in February, 1931, being employed in the corporation's plant at East Chicago, Ind. One year later he became a salesman in the refrigerator car department, with headquarters at Chicago. In 1935 Mr. Selz was elected a vice-president of the General American Precooling Corporation, a subsidiary of General American, and in 1936 became sales executive of the tank car department of the parent company.

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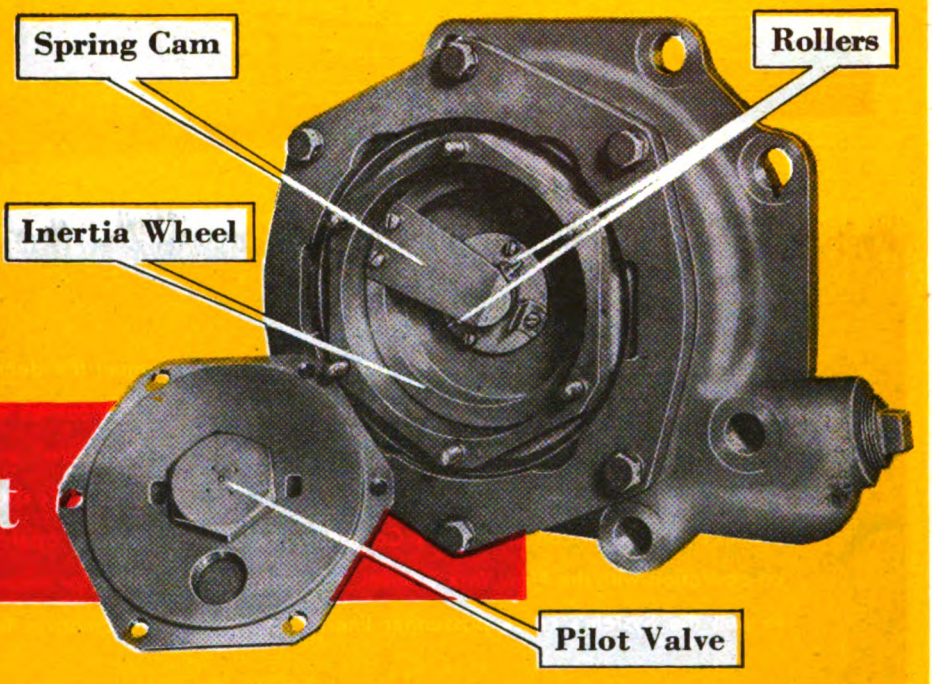
Undercover Operation On the "AP" Decelostat

SOFTENS THE BRAKE
WHEN WHEEL SLIP IMPENDS

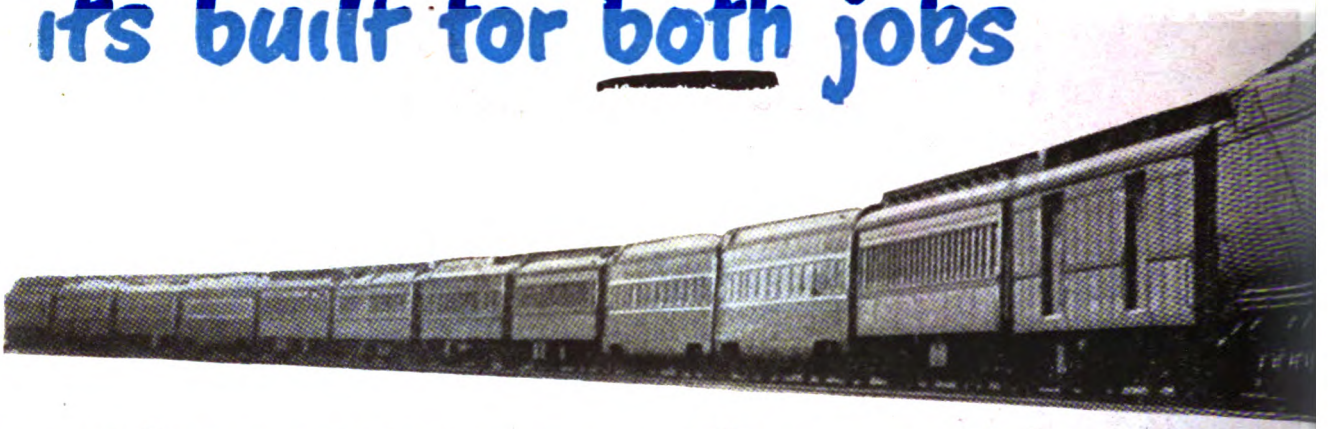


UNDER-THE-COVER inspection of the "AP" Decelostat reveals simplicity achieved by mechanical-pneumatic design. Greater operating reliability naturally stems from design simplification. All apparatus is confined to the truck — initial installation is simplified, less costly. No connections required between truck and car body; maintenance is reduced to a minimum. These features are derived from mechanical-pneumatic design and add up to efficient, dependable wheel slip control.

Westinghouse Air Brake Company

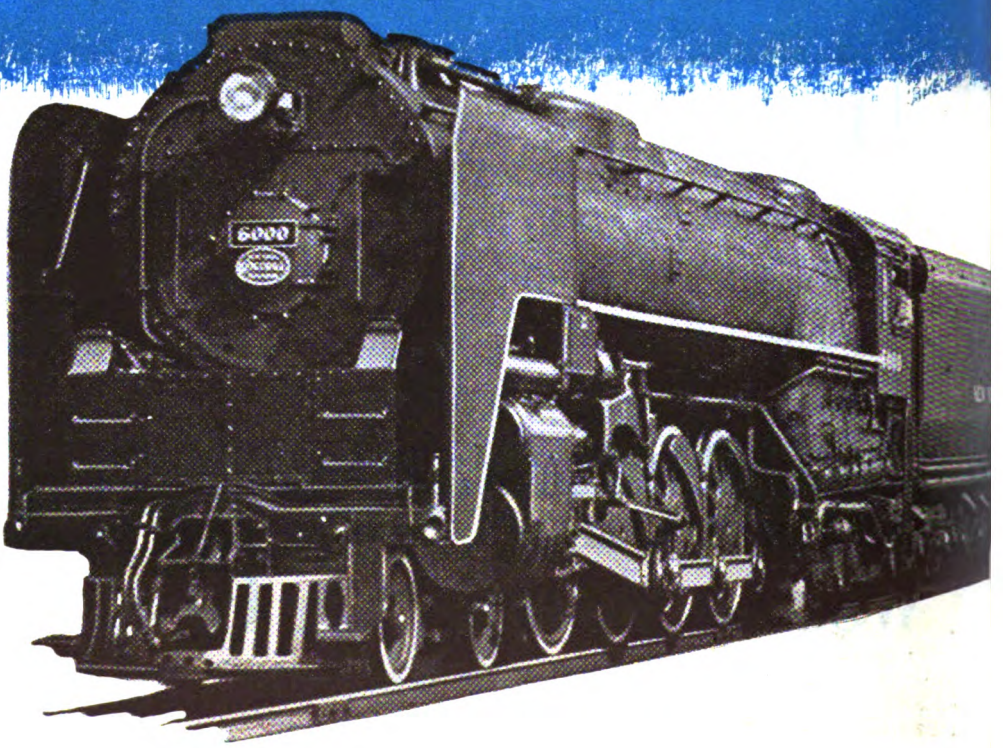
Wilmerding, Pa.

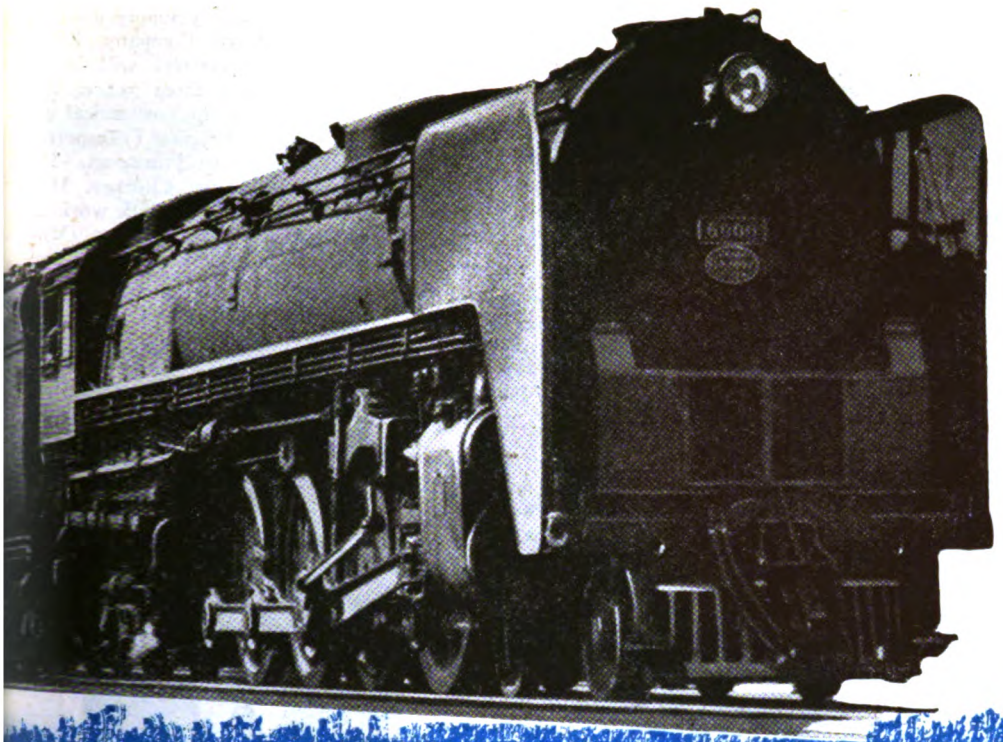
Right for both jobs because it's built for both jobs



THE trains you see on these two pages are being pulled by the New York Central's new dual-purpose locomotive, the "Niagara."

Built by the American Locomotive Company, in close co-operation with the New York Central, it is designed to pull the System's crack passenger liners and also meet the demands for high speeds in hauling freight. Locomotives that possess the *interchangeability* of the "Niagara" promise many benefits. They can help reduce the expense many railroads have had to bear in buying, operating and maintaining powerful locomotives for heavy freight hauls and faster, less powerful locomotives for lighter passenger runs.





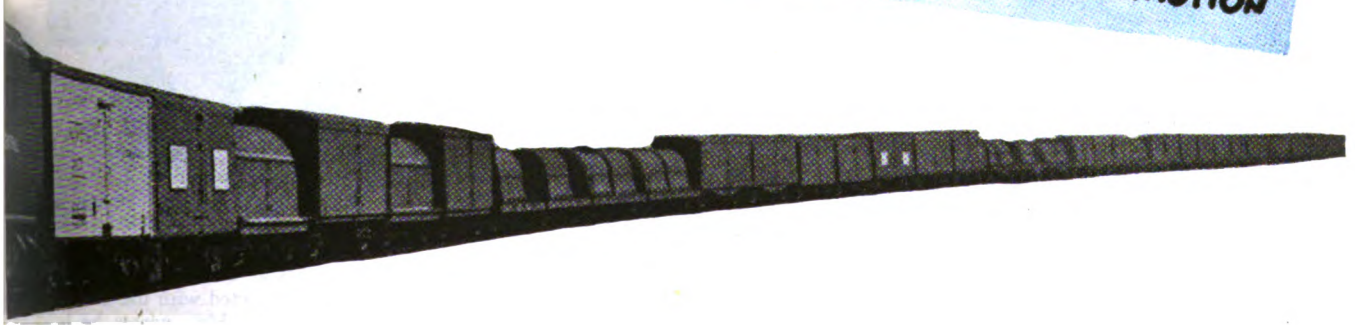
They can provide a new kind of operating efficiency by building up extra power needed for tough jobs, and conserving power on the easier tasks.

And, perhaps most important of all, they can open new roads to undreamed-of economies—savings that will be shared by thousands.

American Locomotive

Alco

THE MARK OF MODERN LOCOMOTION



LINCOLN ELECTRIC COMPANY.—*Gorham W. Woods,* for the past three years process engineer of the Dickson gun plant of the Hughes Tool Company of Houston, Tex., has been appointed research engineer of the Lincoln Electric Company, Cleveland, Ohio.

◆

AMERICAN BRAKE SHOE COMPANY.—*William A. Maxwell,* general sales manager of the P. & M. Company since 1931, has been appointed Chicago district sales manager of the Ramapo Ajax division of

William A. Maxwell

the American Brake Shoe Company. Mr. Maxwell attended Nebraska University. Except for a period of service in the Navy during the last war, he had been associated with the P. & M. Company since 1917.

J. L. Mullin, general superintendent of foundries, has been appointed vice-president in charge of operations of the American Manganese Steel division of the American Brake Shoe Company, with headquarters in Chicago. Mr. Mullin has

J. L. Mullin

been associated with the manganese-steel industry since 1914, when he joined the Edgar Allen Manganese Steel Company, predecessor of the present Brake Shoe division, as a clerk in the annealing department. He then served successively as local purchasing agent, foundry superintendent, works manager at the New Castle, Del., plant, and general superintendent of foundries.

DUFF-NORTON MANUFACTURING COMPANY.—*Walter I. Floyd,* formerly executive vice-president, has been elected presi-

Walter I. Floyd

dent of the Duff-Norton Manufacturing Company to succeed *Robert G. Allen,* who has resigned. *E. M. Webb* has been elected vice-president and general manager.

◆

BALDWIN LOCOMOTIVE WORKS OF CANADA, LTD.—The Baldwin Locomotive Works has formed a wholly owned Canadian subsidiary, the Baldwin Locomotive Works of Canada, Ltd., to market there

W. N. Brownlie

such Baldwin products as turbines, water wheels, hydraulic presses, power tools and Diesel engines. *W. N. Brownlie,* formerly chief engineer of the Mutual Boiler Insurance Company of Boston, Mass., has been appointed managing director, with headquarters soon to be opened in Toronto. The new subsidiary will subcontract its orders to the United Steel Company, Ltd., which has four plants in Eastern Canada and headquarters in Toronto. All production will be under the general supervision of Baldwin of Canada and will be from Baldwin designs and specifications. Other officers of the new company, all of whom are officers of the parent company, include *Ralph Kelly,* president; *W. Horace Holcomb,* vice-president; *H. D. Humphreys,* secretary and treasurer, and *T. E. McFalls,* assistant secretary and assistant treasurer.

REYNOLDS METALS COMPANY.—*Frank J. Swanson* has been appointed sales and service engineer of the railway supply division of the Reynolds Metals Company, Richmond, Va. His headquarters will be in Chicago. For the past three years, Mr. Swanson has served in the mechanical division of the Office of Defense Transportation, Division of Railway Transport. He began his career with the Chicago, Milwaukee, St. Paul & Pacific in 1905, working in the car department at Chicago, Milwaukee, Wis., and Minneapolis, Minn., and in various clerical positions. He served an

Frank J. Swanson

apprenticeship as a carman and subsequently became assistant car foreman, car foreman, general car foreman, assistant shop superintendent, and general car department supervisor. Mr. Swanson joined O. D. T. in June, 1942.

◆

STANDARD RAILWAY EQUIPMENT COMPANY.—*Nicholas H. Arnold* has been appointed assistant to the vice-president of the Standard Railway Equipment Company,

Nicholas H. Arnold

with headquarters at Chicago. Mr. Arnold was previously connected with the Missouri Pacific at St. Louis, Mo., where he held various supervisory positions in the car department for nearly 18 years. In 1943 he was appointed to the United States Railway Mission in Mexico where he assisted in the rehabilitation program of the National Railways of Mexico.

NATIONAL MALLEABLE & STEEL CASTINGS COMPANY.—*Herbert L. Mausk* has been appointed manager of railway sales of the National Malleable & Steel Castings Company. *George R. Farrell* succeeds Mr. Mausk as Cleveland district sales manager and the Cleveland territory has been extended to include the Pittsburgh, Pa., district.

Herbert L. Mausk

Herbert L. Mausk joined National Malleable in the drafting department in 1907, rising to the position of assistant chief draftsman. In 1918 he was assigned to the company's Washington, D. C., railway sales office to assist in engineering work, and later was appointed sales agent in that territory. He returned to the general offices in Cleveland, Ohio, for special engineering work in 1931, and was appointed Cleveland district sales manager in 1933.

George R. Farrell

George R. Farrell joined National Malleable in 1907 as an inspector of railroad materials. In 1912 he was appointed to the service department in connection with the railway sales division of the company's business, and in 1922 was appointed sales agent and assigned to the Philadelphia, Pa., office.

◆

STANDARD STOKER COMPANY.—*E. Archer Turner*, vice-president and general manager, has been elected president of the Standard Stoker Company to succeed *H. P. Farrington*, who becomes chairman of the board. Mr. Farrington will continue active in the executive management. Mr. Turner, who has been associated with the locomotive stoker industry since 1918 and with the Standard Stoker Company since 1928, will make his headquarters in New York. *Karl W. Mueller*, technical assistant to the general manager, has been appointed works manager at Erie, Pa., and *Charles J. Surdy*, executive assistant to the general manager, has been appointed assistant to the president.

◆

ELECTRO METALLURGICAL COMPANY.—*W. E. Remmers*, vice-president of the Electro Metallurgical Sales Corporation, has been elected vice-president of the Electro Metallurgical Company, a unit of the Union Carbide & Carbon Corp.

◆

JONES & LAUGHLIN STEEL CORPORATION.—*J. O'H. Anderson*, manager of sales, tubular products, and *H. B. Spackman*, district sales manager at Philadelphia, Pa., have been appointed assistant general managers of sales. *V. A. Jevon*, assistant general manager of sales, has been placed in charge of Pittsburgh, Pa., district sales office activities. *C. T. Hapgood*, formerly assistant manager of sales, tubular products, has been appointed manager of sales, tubular products. *E. W. Harwell*, formerly district sales manager at Chicago, has been appointed district sales manager, with headquarters at Philadelphia, Pa. *L. C. Berkey*, formerly district sales manager at St. Louis, Mo., has been appointed district sales manager, with headquarters at Chicago. *C. C. Wehling*, formerly district sales manager at Pittsburgh, Pa., has been appointed district sales manager, with headquarters at St. Louis, Mo.

J. O. H. Anderson

H. B. Spackman

V. A. Jevon

The district office of Jones & Laughlin and the office of Jones & Laughlin Supply Company at Chicago have been changed to the Field Building, 135 South LaSalle street, Chicago 3.

◆

UNION SWITCH & SIGNAL COMPANY.—*T. B. Clement* has been elected executive vice-president; *M. L. Gray*, vice-president and export manager; and *R. H. Wood*, general manager, of the Union Switch & Signal Company, all with headquarters at the company's offices in Swissvale, Pa.

George W. Baughman, assistant chief engineer in charge of electronics, has been appointed chief engineer. *George W. Baughman* is a graduate of Ohio State University with a degree in electrical engineering (1920). He was awarded the professional electrical engineering degree in 1924. From 1920 to 1923, he was employed in the development laboratories of the Bell Telephone System. He began work with the Union Switch & Signal Company in 1923 and from then until July, 1944, was engaged chiefly in field-development work associated with railway signaling and braking. He was appointed assistant chief engineer in charge of electronics in July, 1944.

George W. Baughman

(*Turn to second left-hand page*)

Let's get *down to earth*

on train communication

"UNION"

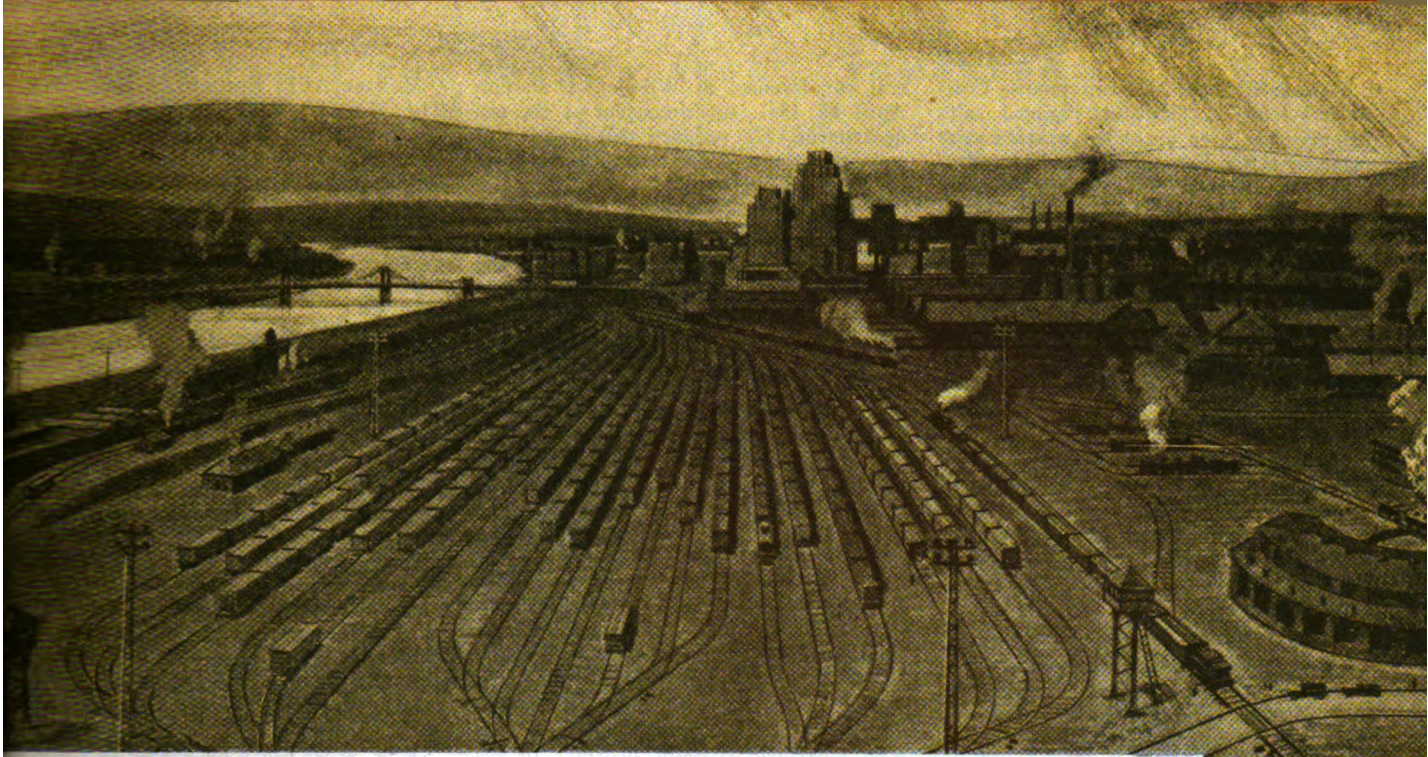
I T C

INDUCTIVE TRAIN COMMUNICATION

Dependable voice communication

"Union" I.T.C. (Inductive Train Communication) system provides dependable, practicable two-way voice communication between vehicles of a train, between trains, and between trains and wayside points.

It is a train communication system designed exclusively for railroad use, by men who know railroad needs, and proved through years of regular railroad service.



This train communication system stays in its own yard

Yard service offers some problems for a train communication system different from those met in main line operation.

For example, many terminal areas include several yards. Communication should be provided between offices and yard locomotives in each yard without interfering with communication in other yards, but locomotives so equipped may sometimes have to be transferred from their normal territories to other yards.

"Union" Inductive Train Communication is the solution to this problem, because the area over which "Union" I.T.C. conversation can be received can be closely limited to the yard territory. As a result it is usually possible for more than one yard in the same terminal area to use the same carrier frequency without interference. When separate channels must be employed, the locomotive apparatus can be selectively switched to the frequency assigned to a given yard area, or alternatively the change in frequency can be quickly accomplished by rapid substitution of the plug-in equipment trays.

This is one more reason why eight railroads have already found that, for dependable train communication, *"Union" I.T.C. is the answer.*

Full information will be furnished without obligation by our nearest district office.

UNION SWITCH & SIGNAL COMPANY

SWISSVALE, PA.

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO

EDWARD G. BUDD MANUFACTURING COMPANY.—*John E. Wright,* regional sales manager has been appointed western sales manager of the Edward G. Budd Manufacturing Company's railway car division, with headquarters in Chicago. *Fitzwilliam Sargent,* regional sales manager, has been appointed eastern sales manager. *Samuel F. Felton,* sales manager, has resigned. *Thomas J. Henkle,* special representative at Chicago, has retired after 27 years of service with the Budd organization. Mr. Henkle had previously served as western sales manager.

◆

LOCOMOTIVE FINISHED MATERIAL COMPANY.—*R. A. Phillabaum,* a former employee of the Wabash and of the New York Central, has been appointed a service representative of the Locomotive Finished Material Company, Atchison, Kan., with headquarters at Chicago.

◆

AMERICAN LOCOMOTIVE COMPANY.—*Paul D. Curtis* has been placed in charge of a new sales office opened by the American Locomotive Company in the First National Bank Building, St. Paul, Minn. *Charles F. Venrick* has been appointed assistant district sales manager in Chicago to succeed Mr. Curtis.

Paul D. Curtis is a graduate of Wisconsin University (1928). He was connected with coal companies in a sales capacity until he became president of the Marquette Railway Supply Company in 1939. He was appointed assistant district sales manager of the American Locomotive Company's Chicago office on January 1, 1941.

Charles F. Venrick is a graduate of Dartmouth College (1936). He joined the American Locomotive Company as a special apprentice at the Schenectady, N. Y., and other plants and has been associated with the Chicago office as sales representative since 1938.

◆

WESTINGHOUSE AIR BRAKE COMPANY.—*Herbert A. May* has been elected assistant to the president of the Westinghouse Air Brake Company. *C. D. Stewart* has been elected vice-president, engineering; *S. L. Poorman,* assistant vice-president, commercial activities; *A. M. Wiggins,* assistant vice-president, patents and legal matters; and *J. S. Smith,* an assistant treasurer. All five have been associated with the company for a number of years.

◆

ENTERPRISE RAILWAY EQUIPMENT COMPANY.—*O. A. Wallace* has been appointed sales engineer of the Enterprise Railway Equipment Company, Chicago. Mr. Wallace was born at Enfield, N. C., on September 29, 1889, and is a graduate of the King's Business College, Raleigh, N. C. He entered the service of the Atlantic Coast Line on May 8, 1910, as a carman apprentice at Rocky Mount, N. C. He subsequently held other positions on that road until 1918 when he went with the Mobile & Ohio (now the Gulf, Mobile & Ohio) as a traveling car inspector, with headquarters at Mobile, Ala. In 1921, Mr. Wallace returned to the Atlantic Coast Line as a general car inspector at Waycross, Ga. In 1924 he became supervisor of car repairs, at Wilmington, N. C.; in 1938 system general car foreman at Wilmington and on April 19, 1941, superintendent of the car department. He resigned that position to enter the service of the Enterprise Railway Equipment Company.

◆

OKONITE COMPANY.—*Robert B. Zane* has been appointed district engineer of the Chicago sales office of the Okonite Company. Mr. Zane is a graduate of Illinois University with a degree in electrical engineering (1932). He joined the Okonite Company as a research engineer in the Passaic, N. J., laboratories. Three years later he was transferred to sales engineering in the company's Chicago office, and in 1943, returned to the factory to participate in development work on high frequency and radar cables for the Army and Navy.

◆

AMERICAN STEEL & WIRE COMPANY.—*Robert E. Cramer,* engineer of appropriations and properties, has been appointed chief engineer of the American Steel & Wire Company, a United States Steel subsidiary, to succeed *E. J. Reardon,* who recently resigned. *Myron E. Capouch* has been appointed assistant manager of the wire rope and construction materials division to succeed B. S. Pease, who has retired. Mr. Capouch was assistant manager of the company's electrical and wire rope department in Chicago.

◆

AMERICAN CAR AND FOUNDRY COMPANY.—*F. F. Rose,* assistant vice-president, has retired after more than 44 years of service in the sales department of the American Car and Foundry Company.

◆

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—*Gwilym A. Price* has been appointed executive vice-president of the Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa. Mr. Price was elected vice-president of the company in September, 1943.

◆

H. K. PORTER COMPANY.—*Col. G. deFreest Larner* has been appointed assistant to the president of the H. K. Porter Company, Pittsburgh, Pa., in charge of termination of war contracts, renegotiation, and special tax problems. *J. C. Hamilton* has been appointed service engineer for Quimby Pumps and Fort Pitt Steel Castings in Chicago and surrounding territories for the Porter Company. Mr. Hamilton previously was with the sales department of the Pittsburgh Equitable Meter Company. *John A. Comstock,* formerly engineering metallurgist with the United Aircraft Corporation of East Hartford, Conn., has been appointed director of research and metallurgy for all divisions of the Porter Company.

Army-Navy "E" Awards

Babcock & Wilcox Company, Alliance, Ohio. Third renewal.

Electric Storage Battery Company, Philadelphia, Pa. Fifth star.

Maxim Silencer Company, Hartford, Conn. Third star.

Standard Stoker Company, New York, Renewal.

MONROE AUTO EQUIPMENT COMPANY.—The Monroe Auto Equipment Company, Monroe, Mich., has purchased a private Pullman car for test purposes in further developing and improving vertical and horizontal shock absorbers, sway bars, anti-galloping devices and other equipment designed to improve the riding qualities of railroad cars.

◆

CRANE COMPANY.—*P. R. Mork,* vice-president in charge of sales, has been elected executive vice-president of the Crane Company, Chicago, and *J. A. Dwyer,* general manager of sales and branches, has been elected vice-president in charge of sales. *Lucien W. Moore* has been appointed general manager of sales and branch houses to succeed Mr. Dwyer. *F. J. Wilkey,* district manager, Chicago, has been appointed manager of the valve and fitting department, the position occupied by Mr. Moore until his recent assignment to a special mission in France by the War Department. Mr. Moore will assume his new duties on completion of his present mission for the government.

P. R. Mork began his career in the company's Minneapolis branch warehouse in 1901. He was appointed manager of the Duluth, Minn., branch in 1911; appointed manager of the Minneapolis branch in 1924; manager of the New York branch in 1927, and vice-president in 1931. He was transferred to the general office in Chicago as vice-president in charge of sales in 1934. After military service in the first world war, Mr. Dwyer returned to the Crane branch in Philadelphia, Pa., and was successively estimator, salesman, chief clerk, sales manager, assistant branch manager, and, in 1935, manager. He became district manager in 1937, was transferred to Chicago as manager of branch houses in 1943, and appointed general manager of sales and branches in January, 1944.

◆

A. M. BYERS COMPANY.—A. Milne & Co. has been appointed national distributor for wrought-iron bars manufactured by the A. M. Byers Company, Pittsburgh, Pa. The Milne organization operates warehouses in New York, Chicago, Boston, Mass., and Pittsburgh, Pa., and Philadelphia, and an office in Washington, D. C.

◆

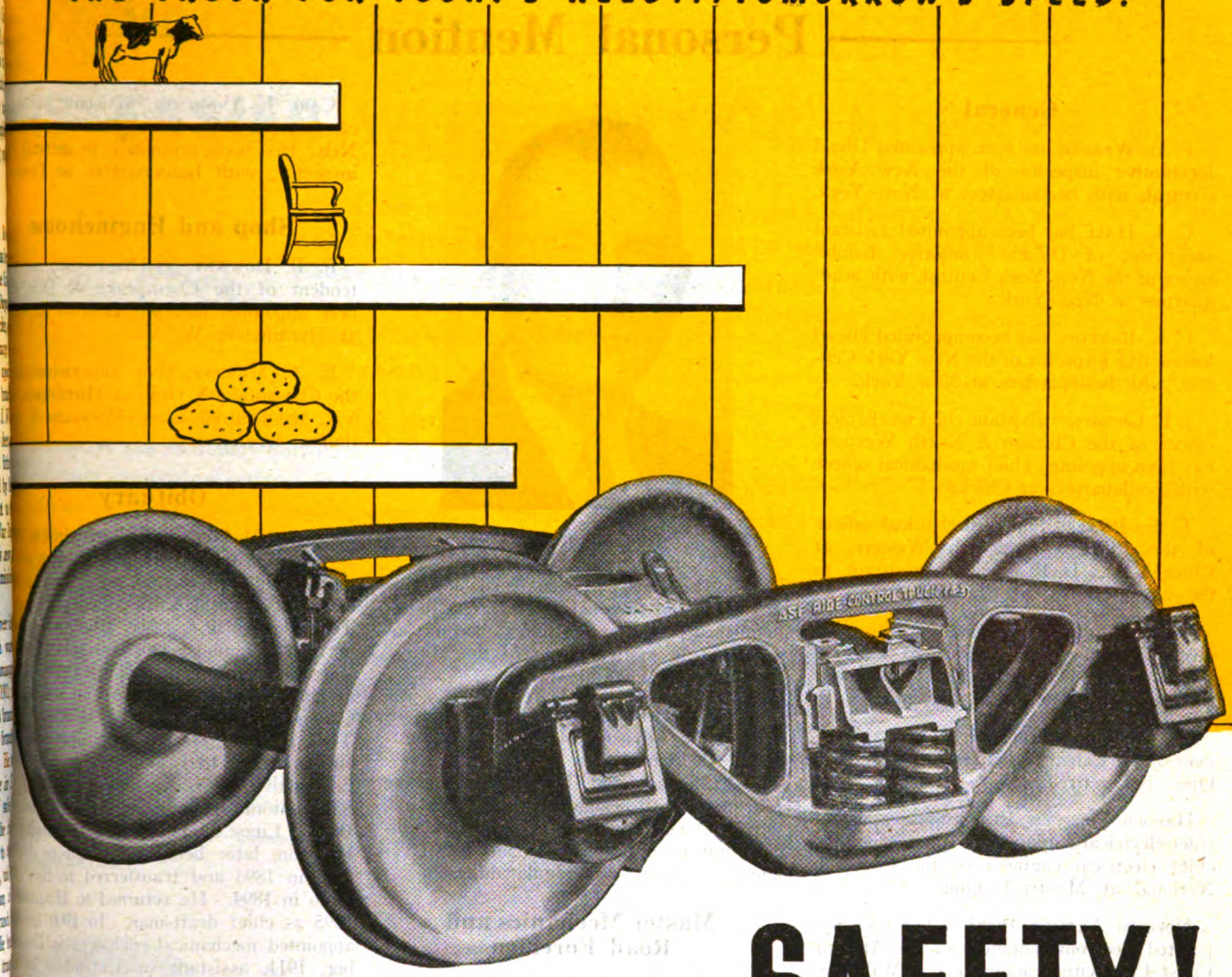
PITTSBURGH STEEL COMPANY.—*Carl L. Zak,* manager of tubular sales, has been appointed assistant general manager of sales of the Pittsburgh Steel Company, Pittsburgh, Pa. *E. R. Smith,* assistant manager of sales, oil country tubular goods, has been appointed manager, oil country tubular sales.

Obituary

CHARLES F. KRAUSS, assistant chief engineer of the locomotive and ordnance division of the Baldwin Locomotive Works, who was in charge of new development work on locomotives, died April 6. Mr. Krauss had been associated with Baldwin for 40 years, starting in the engineering department. He attended the Drexel Institute of Technology and was a member of the technical committee of the Locomotive Institute and of several committees of the Association of American Railroads.

(*Turn to next left-hand page*)

THE TRUCK FOR TODAY'S NEED . . . TOMORROW'S SPEED!



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CONSTANT FRICTION CONTROL

Today's climbing loss-and-damage figures are variously laid to the inevitable effects of war—acute shortage and rapid turnover of labor; increasing use of worn and reused containers; inadequate packaging; and inattention to sound freight-handling practices. Each *is* a contributory factor. And there is one more—the freight car itself or, more specifically, the *trucks* on which it rides. Much in this direction *can* be done to ease freight smoothly along the rails despite wartime difficulties. The A. S. F. Ride-Control Truck (A-3) gives freight a smooth, easy ride.

AMERICAN STEEL FOUNDRIES

CHICAGO

MINT-MARK OF FINE CAST STEEL

Personal Mention

General

F. E. WEAVER has been appointed Diesel locomotive inspector of the New York Central, with headquarters at New York.

C. L. HALL has been appointed assistant supervisor of Diesel locomotive maintenance of the New York Central, with headquarters at New York.

F. K. BARTHOL has been appointed Diesel locomotive inspector of the New York Central, with headquarters at New York.

J. E. GOODWIN, assistant chief mechanical officer of the Chicago & North Western, has been appointed chief mechanical officer with headquarters at Chicago.

T. F. POWERS, chief mechanical officer of the Chicago & North Western at Chicago, has been appointed assistant to the vice-president, at Chicago.

G. W. BOHANNON, assistant to the chief mechanical officer of the Chicago & North Western, has been promoted to assistant chief mechanical officer at Chicago.

RAMSEY GRAY GAGE, chief electrical engineer of the Canadian National at Montreal, Que., has retired.

HAROLD FORSYTH FINNEMORE, assistant chief electrical engineer, has been appointed chief electrical engineer of the Canadian National at Montreal, Que.

NORCUM ARTHUR PEEBLES has been appointed electronic engineer of the Atlantic Coast Line with headquarters at Wilmington, N. C.

HAROLD C. WRIGHT, master mechanic of the Altoona works of the Pennsylvania at Juniata, Pa., has been appointed superintendent of motive power, Eastern Ohio division, with headquarters at Pittsburgh, Pa.

C. P. KAHLER, electrical engineer of the Union Pacific at Omaha, Neb., has been promoted to general electrical engineer, with headquarters at Omaha.

JOHN MILES NIXON, whose appointment as superintendent, motive power of the Macon, Dublin & Savannah at Macon, Ga., was announced in the May issue, was born at Rhine, Ga., on February 3, 1901, and entered the service of the Georgia & Florida in November, 1918, as an apprentice machinist at Douglas, Ga. In 1920, he became a machinist in the employ of the Atlanta, Birmingham & Atlantic (now the Atlanta, Birmingham & Coast) at Fitsgerald, Ga., and later served as a machinist on the Southern, the Atlanta & St. Andrews Bay, and the Cincinnati, New Orleans & Texas Pacific (part of the Southern). In March, 1926, he entered the employ of the Florida East Coast as head machinist at Miami, Fla., and became inspector in September, 1932. In May, 1937, he became a machinist for the Seaboard Air Line at Jacksonville, Fla., and later served at Miami, Fla. Mr. Nixon was appointed enginehouse foreman at Wildwood, Fla., in January 1941. In April, 1942, he was promoted to general foreman. He relinquished the latter position to become superintendent, motive power of the Macon, Dublin & Savannah at Macon.

John Miles Nixon

A. G. TRUMBULL, chief mechanical engineer of the Advisory Mechanical Committee of the Chesapeake & Ohio, the New York, Chicago & St. Louis, and the Pere Marquette with headquarters at Cleveland, Ohio, has been appointed general mechanical engineer of the three roads at Cleveland, in addition to his regular duties.

Master Mechanics and Road Foremen

CLAIR I. CLUGH, master mechanic of the Philadelphia Terminal division of the Pennsylvania at Philadelphia, Pa., has been transferred to the position of master mechanic, Pittsburgh, Conemaugh and Monongahela divisions, with headquarters at Pitcairn, Pa.

HERBERT J. KLEINE, master mechanic of the Pittsburgh, Conemaugh and Monongahela divisions of the Pennsylvania at Pitcairn, Pa., has been transferred to the position of master mechanic at the Altoona works, Juniata, Pa.

G. M. DUCK, traveling master mechanic of the Gulf, Mobile & Ohio, has been appointed master mechanic of the Northern division, with headquarters at Jackson, Tenn.

E. D. BURKE, district foreman of the Union Pacific, at La Grande, Ore., has been promoted to assistant master mechanic, with headquarters at Cheyenne, Wyo.

C. T. ARMSTRONG, assistant master mechanic of the Union Pacific at Cheyenne, Wyo., has been transferred to the position of assistant master mechanic at North Platte, Neb.

Car Department

OREL C. FARISS has been appointed superintendent, car department, of the Virginian, with headquarters at Princeton, W. Va.

CARL J. ANDERSON, assistant passenger car foreman of the Union Pacific at Omaha, Neb., has been promoted to general car inspector, with headquarters at Omaha.

Shop and Enginehouse

F. B. DOWNEY, assistant shop superintendent of the Chesapeake & Ohio, has been appointed superintendent of the shops at Huntington, W. Va.

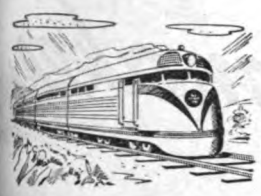
E. A. MURRAY, shop superintendent of the Chesapeake & Ohio at Huntington, W. Va., has retired after 55 years of continuous service.

Obituary

GEORGE MCCORMICK, who retired in 1942 as general superintendent of motive power of the Southern Pacific, with headquarters at San Francisco, Calif., died at Houston, Tex., on April 5. Mr. McCormick was born at Columbus, Tex., on July 15, 1872, and was a graduate in mechanical engineering of the Agricultural and Mechanical College (now Texas A. & M.) at Bryan, Tex., in 1891. He entered railway service on October 5, 1891, as a machinist apprentice with the Galveston, Harrisburg & San Antonio (now part of the Southern Pacific Lines in Texas and Louisiana) at Houston, later being promoted to draftsman in 1893 and transferred to San Antonio in 1894. He returned to Houston in 1895 as chief draftsman. In 1900 he was appointed mechanical engineer; in December, 1911, assistant superintendent of the El Paso division, with headquarters at El Paso, Tex.; in February, 1913, assistant general manager (mechanical) of the Southern Pacific, Texas lines, with headquarters at Houston, and in December, 1916, general superintendent of motive power. More complete biographical data concerning the training and accomplishments of Mr. McCormick, who received the honorary degree of Doctor of Engineering at Texas Agricultural & Mechanical College in 1941, appeared in the January, 1942, issue of the *Railway Mechanical Engineer*, beginning on page 15.

George McCormick

YOUR BOILER "HOUSEKEEPING" IS EASIER WITH APEXIOR NUMBER 1



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Your first experience with APEXIOR NUMBER 1 on locomotive and stationary boiler shells and other steam-and-water contacting surfaces is a satisfying discovery. Dirt and scale lose their clinging power and come off easily. There is no chemical bonding of scale to metal. Cleaning time is reduced and the work is lighter. Under the surfacing, a few thousandths of an inch thick, the metal is clean and *sound.*

Many years of service experience, on thousands of locomotives subject to Interstate Commerce Commission inspection, show that brush-applied APEXIOR NUMBER 1 coatings penetrate the pores and joints preventing acceleration of stress corrosion or embrittlement due to water contact. APEXIOR NUMBER 1 is recommended by all boiler insurance companies in the United States and Canada.

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APEXIOR NUMBER 1 is neutral to all standard feedwater chemical treatments and preparations and acts as a supplement to the work of the chemist or water service engineer. It remains stable under boiler water and steam temperatures and pressures.

FOR COLD WATER STORAGE

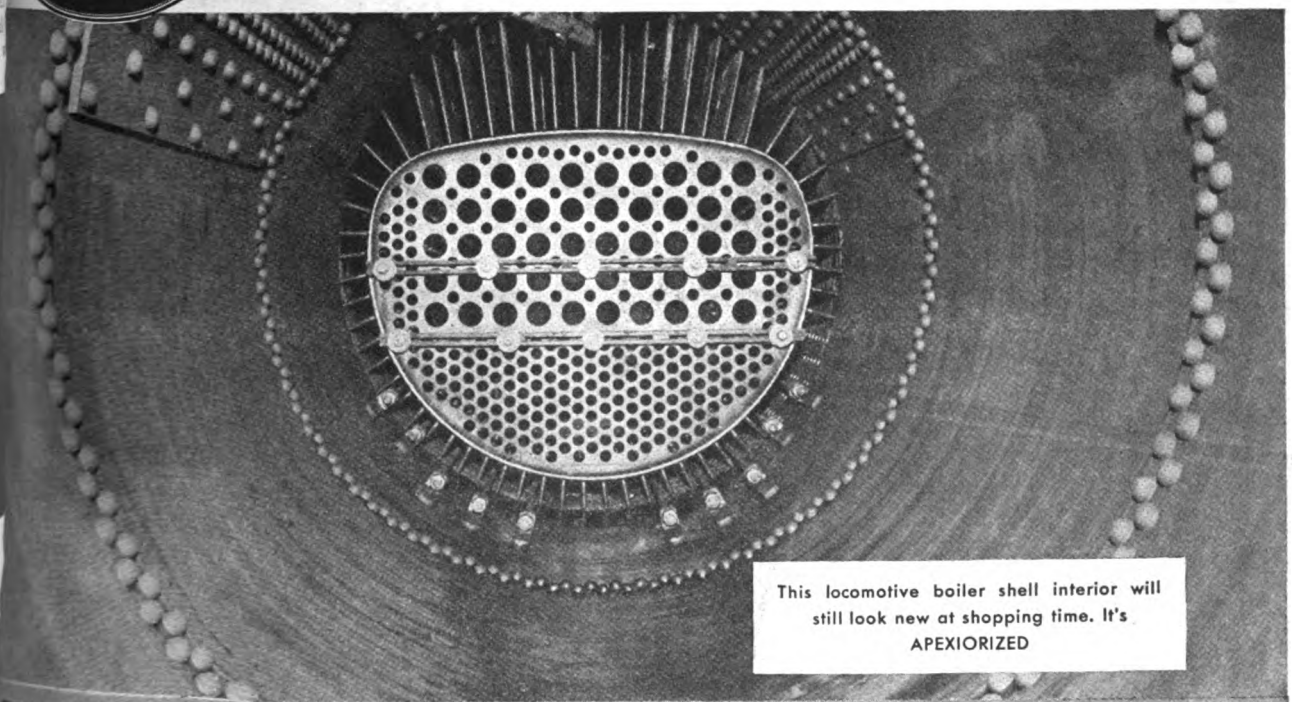
APEXIOR NUMBER 3 protects the water-side of tender cisterns and water storage tanks. It is brush-applied and dries to a jet-black, smooth, shiny surface. It is inert to all boiler-water-treating chemicals and to potable water.

YOU CAN GET APEXIOR

Both APEXIOR surfacing materials are being manufactured in increased quantities to meet the growing demands of industrial power plants, utilities, marine users and railroads throughout the country. Shipments are made every day. Write today for your copy of a bulletin telling how APEXIOR can save metal, time and money for you.

APEXIOR

Keeps new metal new . . . Gives old metal new life



This locomotive boiler shell interior will still look new at shopping time. It's APEXIORIZED

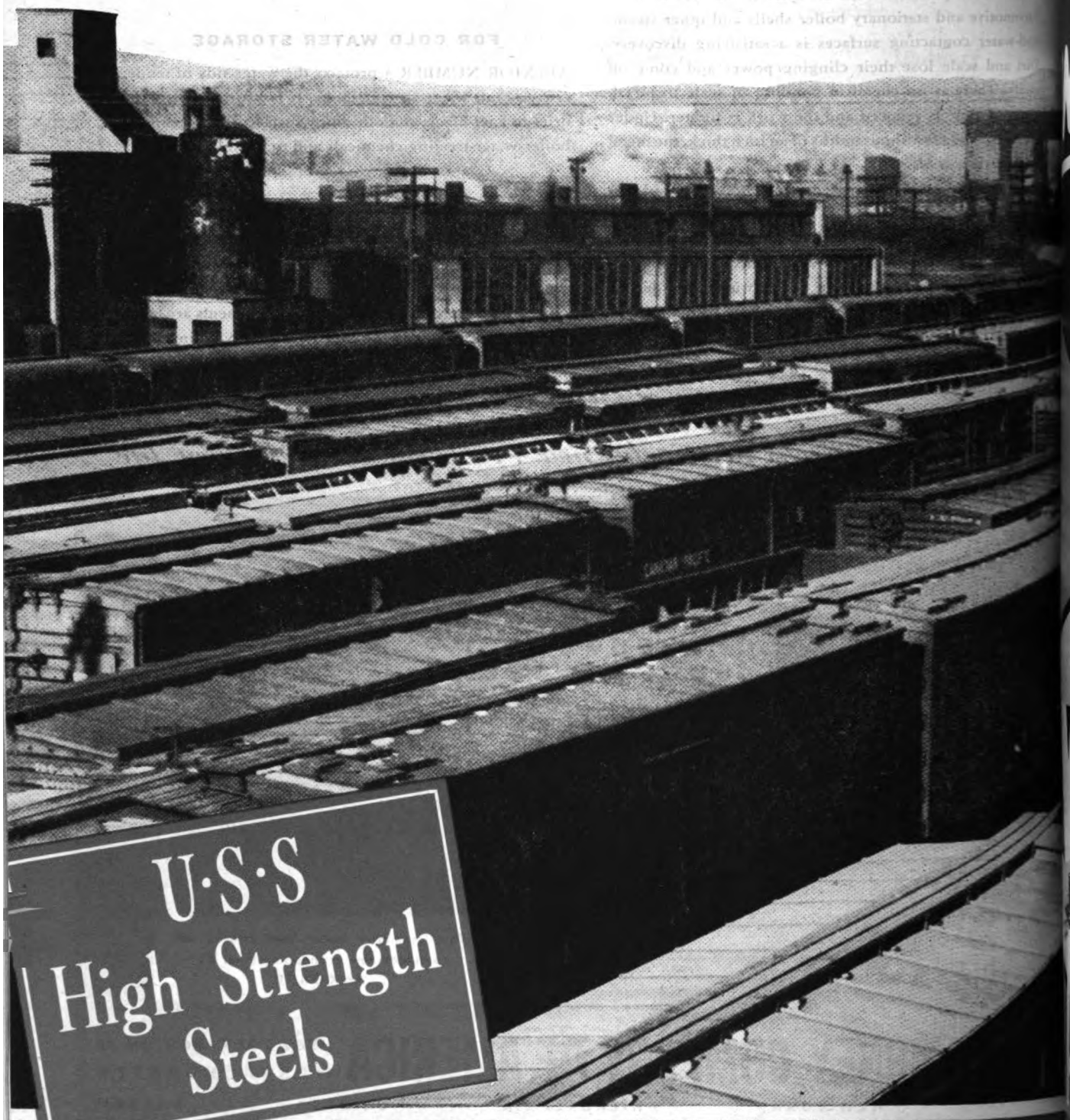
THE DAMPNEY COMPANY OF AMERICA

HYDE PARK, BOSTON 36 MASSACHUSETTS

ATLANTA NEW YORK PHILADELPHIA CHICAGO DETROIT

NOW, WHEN EVERY TON OF CARRYING CAPACITY COUNTS . . .

Deadweight reduction makes



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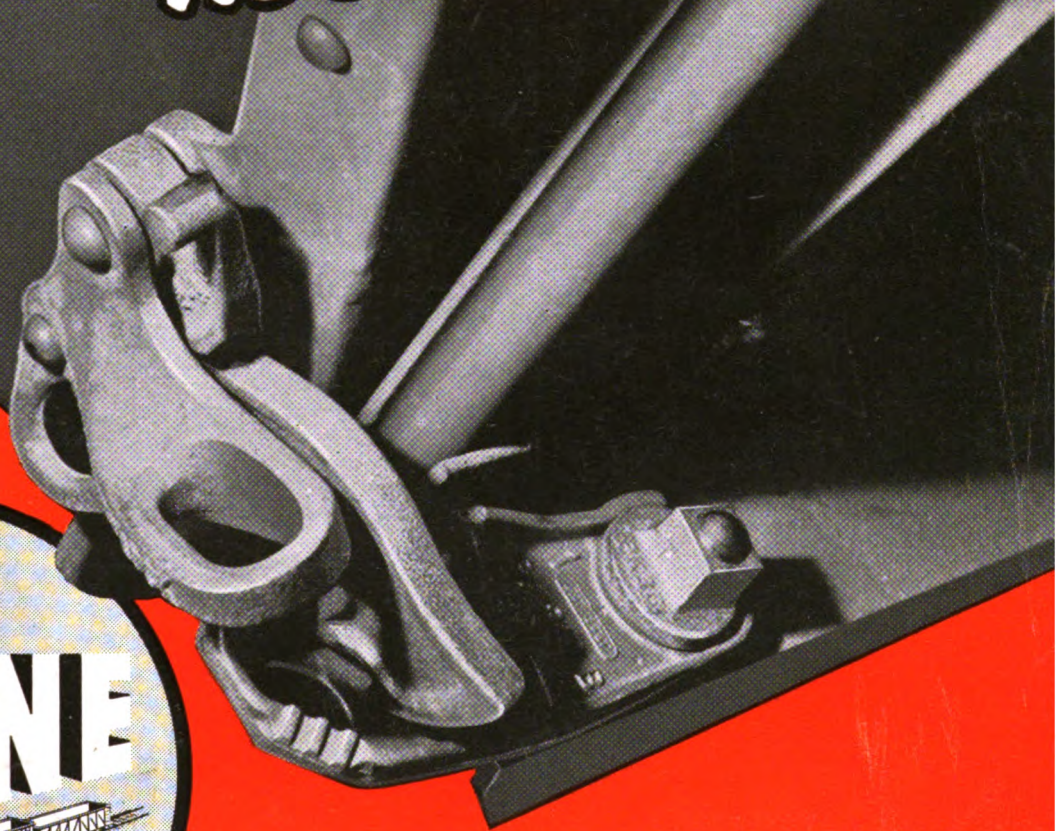
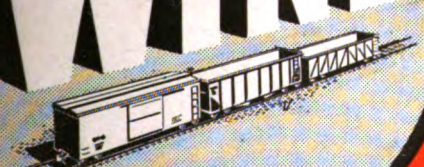
UNIFORM HOPPER DOOR ADJUSTMENT



WINE



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THE WINE RAILWAY APPLIANCE CO. TOLEDO 9, OHIO

UNIT TRUCK

MEMO TO OPERATING OFFICIALS

Here's an unretouched photo of a Unit Brake Beam after 605,817 miles of service.

Unit Truck Corpor

UNIT TRUCK CORPORATION

140 CEDAR STREET NEW YORK, 6, N. Y.

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(Name Registered, U. S. Patent Office)
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Electrical Editor, New York

E. L. Woodward
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JULY, 1945

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Today's Staybolt Job is *tough* but so is

BYERS STAYBOLT IRON

This view inside a firebox shows some of the thousands of staybolts, made from Byers Staybolt Iron, that help to keep this locomotive's availability high, and so help the railroads to continue their miracles of transportation.

During this war period, locomotives have probably handled heavier loads at higher average speeds, and gone further between shoppings, than ever before in history. And it is worthy of note that on an overwhelming majority, the staybolts that helped do the job were wrought iron. As many an old boiler maker will say, there's no substitute for this time-proven material.

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Every step in manufacture is carried on under close control, so that Byers Staybolt Iron is unusually uniform in analysis, structure and dimension. The material is ductile and malleable which facilitates heading. And it has excellent resistance to corrosion and to high firebox temperatures. Of especial importance to roads with extensive locomotive repair or construction programs is the favorable delivery situation on Byers Staybolt Iron. Not only are we able to take care promptly of the requirements of the military . . . we are also able to fill promptly the needs of domestic railroad users.

Over 75 railroads have utilized Byers Staybolt Iron, which is an excellent index to its service qualities. You can order Byers Staybolt Iron for fabrication in your own shops or specify it when you order from a staybolt manufacturer.

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CORROSION COSTS YOU MORE THAN WROUGHT IRON

FORGING BILLETS. The same unusually high quality and uniformity found in Byers Staybolt Iron is duplicated in Byers Forging Billets. They are produced in round, square or rectangular sections, under ASTM-A-73 and AAR-M-307 Specifications.

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TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE ALLOY STEELS · OPEN HEARTH ALLOY STEELS

CARBON STEEL TUBULAR PRODUCTS

Test-Plant Tests of Pennsylvania Duplex Locomotives*

By Ralph P. Johnson†

The type proposed by Baldwin and fitted with poppet valves developed over 6,500 i.hp. with a steam rate of 15.4 lb. – Over 100,000 lb. of evaporation per hr.–Mechanical efficiency high

In the last ten years the increasing weight and length of passenger trains, combined with a continually rising demand for speed, has focused attention on motive-power design for this exacting type of service. The 4-8-4 type steam locomotive has been quite generally accepted in the United States as the best answer in this field, especially as it can double efficiently in fast-freight service.

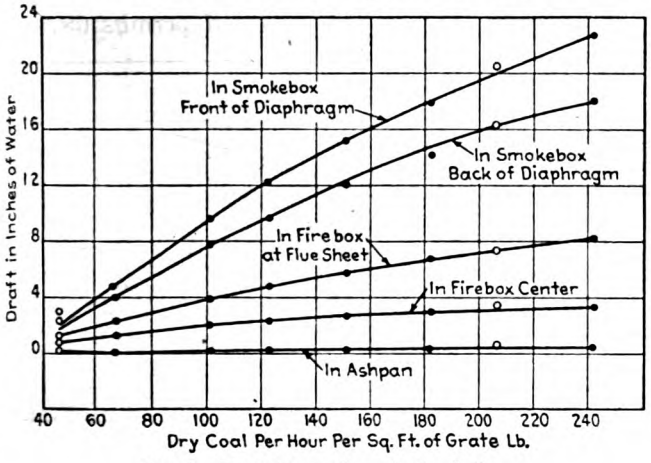


Fig. 1—Draft losses through the boiler

Coincident with the use of the 4-8-4 for fast, heavy service came a breakdown of the old habit of changing locomotives with the varying characteristics of the terrain. The 4-8-4, with its big boiler and high wheels, is at its best possibly over fairly level country, but its weight also enables it to do an effective job in mountainous regions. This resulted in longer and longer locomotive runs until now it is common to run this type of locomotive as much as 1,800 miles at a time. This type of operation makes monthly averages of 20,000 miles fairly common.

Naturally, the more intensive use of power showed

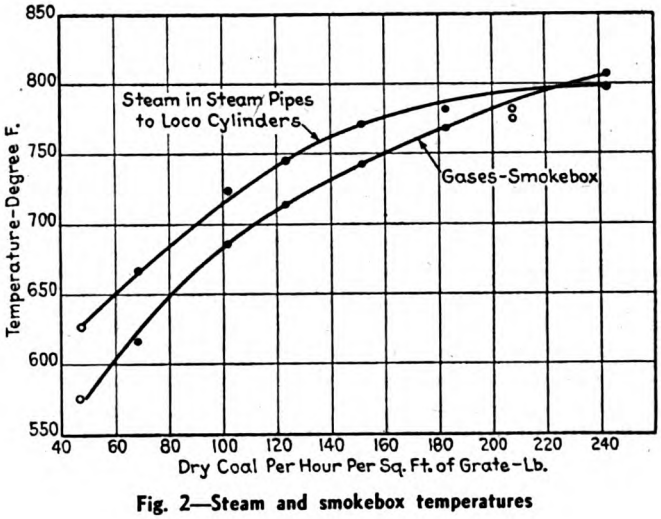
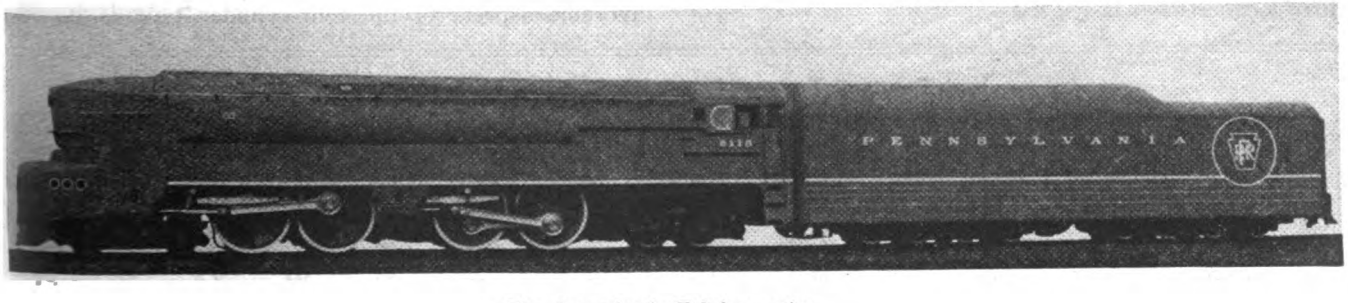


Fig. 2—Steam and smokebox temperatures



The Pennsylvania T-1 locomotive

* From a paper presented before the May 17 meeting of the New York Railroad Club.

† Chief engineer, Baldwin Locomotive Works.

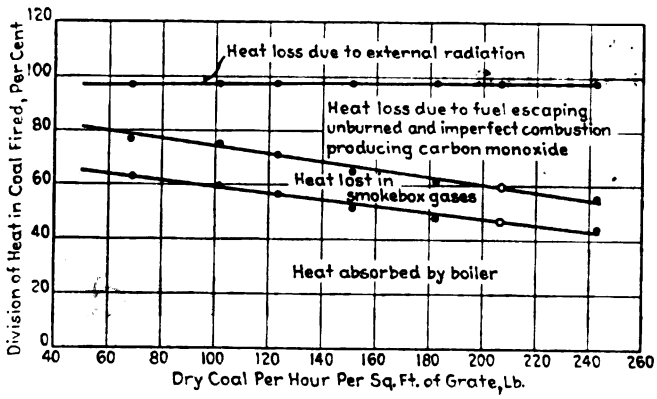


Fig. 3—Heat balance

the necessity for high-class maintenance and justified the use of such devices as roller bearings not only on axles but on main and connecting rods as well. Designers began to give intensive thought to means of increasing availability and lowering maintenance time and costs.

One of the means for accomplishing this which suggested itself was the lowering of the piston thrust on crank pins by using four smaller cylinders in place of the two cylinders of conventional design. Many of the modern 4-8-4 type locomotives with boiler pressures around 275 lb. per sq. in. have piston thrusts of 160,000 lb. and one fleet with 300 lb. per sq. in. boiler pressure has 185,000 lb. Such thrusts require large crank-pin bearings, but the lengths of crank pins are restricted by clearances and the diameters by available space in the wheel center. With four cylinders the piston thrust can be cut in half and, even with 300 lb. per sq. in. boiler pressures, can be brought down to 90,000 lb. This smaller load makes possible smaller bearings at the back end of the main rod and eliminates heavy moving parts.

Why the Four-Cylinder Locomotive?

Four-cylinder locomotives have been common for years, but with articulated frames. Such engines, while powerful, were not suited to high speeds, since the front unit is not sufficiently stable; spring-centering devices are not effective against slight lateral displacements. In addition, the hinged connection between front and rear units has always been a high maintenance item. A four-cylinder arrangement, with a rigid frame and rear cylinders between the two groups of driving wheels had been proposed by the Baldwin Locomotive Works several times, notably in March, 1932, to the Baltimore & Ohio, in December, 1935, to the Florida East Coast, and in January, 1936, to the New York, New Haven & Hartford. This design had been rejected in all cases on account of the long rigid wheelbase. George Emerson of the B. & O. attempted to overcome this objection by building a four-cylinder, non-articulated locomotive in 1937, with the rear cylinder back of the driving wheel. This arrangement, however, is undesirable for various reasons:

(1) The cylinder, guides, and crosshead are in a very dirty location.

(2) The location is cramped and inaccessible and it is difficult to get steam and exhaust pipes into the available space.

(3) The rear unit is running "backward" in forward motion, which means that the crosshead thrust is downward and multiple-bearing guides have to carry this additional load entirely on the ledges.

(4) A very short main rod is required unless the cylinder is placed far under the firebox.

(5) Very little is gained in overall length of locomotive as saving in rigid wheel base is cancelled by longer overhang due to moving the grate further to the rear to avoid contraction of the ash pan by the rear cylinder saddle.

For the above reasons we prefer the four-cylinder locomotive of our own design.

In addition to the lower piston thrusts of the four-cylinder type, the arrangement allows the use of a shorter stroke, as less strength is required for axles and crank pins and the smaller diameters allow them to be placed closer together in the wheel centers. This, in turn, results in lower piston speeds. As indicator-card areas are governed by revolutions per minute and piston speeds, the lower piston speeds give a bigger card area and, hence, higher mean effective pressures.

Furthermore, this type of locomotive permits the most

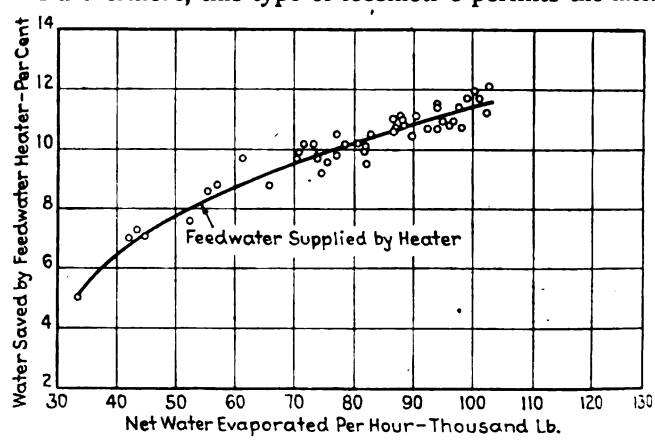


Fig. 4—Saving effected by the feedwater heater

simple driving-rod arrangement with the best possible conditions at the main side-rod connection which need only be large enough to transmit the load to one pair of drivers as contrasted with the large side-rod connection necessary on a 4-8-4 type locomotive to transmit the load to three pairs of drivers.

Again, it is a fundamental fact that as the number of coupled drivers increases, so also does machine friction. Splitting up the drivers of a 4-8-4 type locomotive into two groups, as in the 4-4-4-4 type, or of a 2-10-4 type into a 4-4-6-4 type, reduces the machine friction, thus giving higher drawbar pull, especially at high speeds.

When Baldwin first started work on four-cylinder designs, a commercial poppet-valve gear was not available, but even without the poppet valve one of the most favorable aspects of the four-cylinder type is its im-

High Points of Tests of Pennsylvania T-1 Class Locomotives

Test No.	Test designation	Speed, m.p.h.	T.F. from i.hp.	Steam rate, lb.	Total evaporation, lb.	Total coal consumption, lb.	Firing rate, lb. per sq. ft. per hr.	I.hp.	Pressures, lb. Boiler	Steam pipe	Exhaust passage	Steam temperature, deg. F.	Superheat, deg. F.
1,473	160-50-F	38	47,743	16.3	80,620	13,703	150.1	4,838	296	292	18.1	741	322
1,427	240-40	57	40,094	15.6	96,574	19,340	211.8	6,105	297	292	19.3	738	319
1,406	280-30	67	34,004	15.4	94,236	16,970	185.9	6,021	293	281	15.3	738	320
1,442	320-35	76	31,993	15.3	101,583	22,629	247.8	6,484	294	286	29.4	799	381
1,414	360-25	86	28,737	15.4	102,816	18,370	201.2	6,552	295	287	24.2	757	339
1,444	400-20	95	25,832	14.7	97,949	19,536	214.0	6,544	295	288	25.0	781	363
1,448	420-20	100	25,048	15.6	105,475	24,000	262.9	6,666	296	288	25.9	728	310

proved ability to handle steam through four piston valves, rather than two. A 4-8-4 type locomotive with a 27-in. cylinder and a 12-in. piston valve is definitely crippled at speeds by the inability of the valve to handle steam efficiently. In the case of an equivalent 4-4-4-4 type we would have four 20-in. diameter cylinders and four 12-in. diameter piston valves, which is equivalent to a 24-in. piston valve with a 28-in. cylinder, as the area of two 20-in. cylinders is the same as that of a 28-in. cylinder. Thus, the ratio of valve diameter to cylinder diameter is increased from 44 per cent on the 4-8-4 type to 86 per cent on the 4-4-4-4 type, with a consequent ability to handle steam more efficiently.

All of these considerations prompted the Baldwin Locomotive Works to place a stock order to design and build a 4-4-4-4 type locomotive for demonstration purposes in high-speed heavy passenger service, and this decision was made in October, 1939. However, before we could build this demonstrator, a great railroad company stepped in and gave us an order.

The Pennsylvania T-1 Class

The Pennsylvania in 1937, in search for better steam power, had formed an advisory committee composed of the chief engineers of the three largest locomotive builders, and as a result of their work built at Altoona the four-cylinder locomotive known as the S-1. This was exhibited in 1939 and 1940 at the World's Fair in New York. After the Fair this locomotive was placed in service, but was necessarily restricted to certain territories on account of its large size. Nevertheless, the Pennsylvania's experience with this locomotive convinced them that the four-cylinder rigid-frame type had many advantages. Further, they were forced to a considerable amount of double-heading of passenger trains, so when the Baldwin Locomotive Works submitted their specification for a four-cylinder type, smaller than the S-1 but more powerful than any other passenger locomotive yet

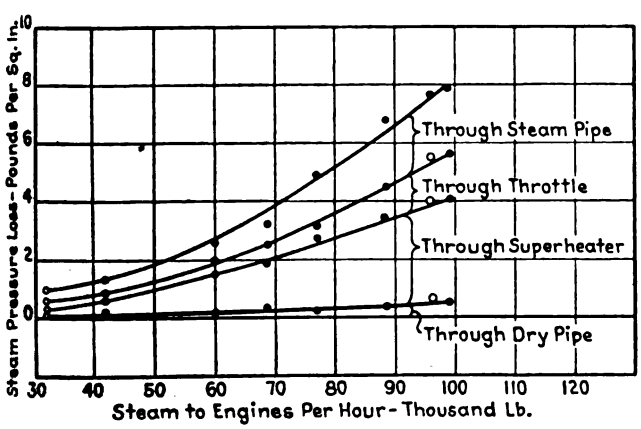


Fig. 5—Steam pressure losses from the boiler to the cylinders

designed, the Pennsylvania promptly placed an order for two on July 30, 1940. They gave the class number "T-1" to these two locomotives and, thus, became the pioneer railroad in the use of this new engine.

The locomotive was designed to haul a trailing load of 880 tons (eleven 80-ton passenger cars) at 100 miles per hour on level, tangent track, and to traverse 15-deg. curves at a maximum speed of 15 m.p.h. It was expected to evaporate a maximum of 85,000 lb. of water. When first planned, piston valves were considered, but before being built tests by the Pennsylvania with a poppet-valve gear on one of their K-4s, a 4-6-2 type locomotive, indicated at least a 20 per cent improvement in efficiency.*

As the proposed locomotive was intended to operate at speeds of 100 m.p.h. and over, the Baldwin Locomotive Works recommended that the two locomotives, to be known as the T-1 class, be equipped with this type of gear. To this the Pennsylvania acceded.†

The first of these locomotives was delivered to the railroad on April 22, 1942, and the second on May 21, 1942. The front ends required some adjustment for proper steaming and the locomotives were then placed in fast-passenger service between Harrisburg and Chicago.

Locomotive No. 6110 made its first through test run

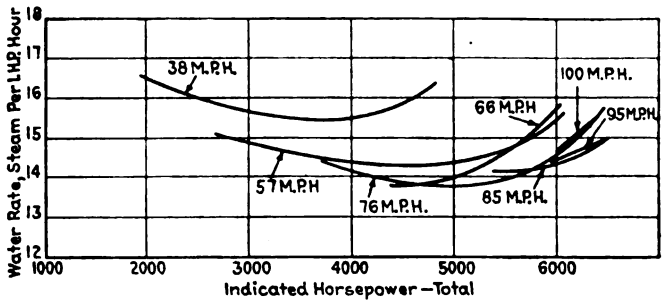


Fig. 6—Steam per indicated horsepower hour

from Harrisburg, Pa., to Chicago with a train of 14 coaches weighing 1,000 tons. It had no trouble in bettering the normal schedule, leaving Crestline, Ohio, 15 min. late and arriving at Fort Wayne, Ind., 5 min. ahead of schedule. It left Fort Wayne 3 min. late and arrived in Chicago 10 min. ahead of schedule. From Crestline to Chicago the speed was consistently around 100 m.p.h.

On another test trip, locomotive No. 6111, hauling 16 cars, covered 69 miles on the Fort Wayne division at an average speed of 102 miles per hour.

These locomotives proved themselves so powerful that they were reserved for heavy passenger trains which otherwise would require double heading.

In April, 1944, locomotive No. 6110, having accumulated about 120,000 miles in road service, was sent to the Altoona test plant for a complete test. The test plant was rebuilt to accommodate her and a test program devised to explore her capabilities thoroughly.

Steam Passages and Gas Areas

In order to keep the pressure drop from the boiler to the cylinders as low as possible, the steam passages were made large. They are shown in the table.

Areas of Steam Passages

	Sq. In.
Dry pipe	78.9
Superheater elements	137.6
Throttle	101.7
Steam pipe (each)	63.6

The resistance of the flues to the passage of the gases of combustion depends upon the area of the openings through the flues and the hydraulic depth of the flues (hydraulic depth is the cross-sectional area of the flue through which the gases flow, divided by the gas-swept perimeter). As this resistance is an important factor in the capacity of the boiler, these dimensions are of interest.

* For road tests of Pennsylvania locomotive No. 5399 equipped with the Franklin system of steam distribution see the April, 1941, *Railway Mechanical Engineer*, page 125. For the results of test-plant tests, see the May, 1941, *Railway Mechanical Engineer*, page 169.

† For a description of the Pennsylvania T-1 locomotive see the January, 1943, *Railway Mechanical Engineer*, page 1.

Gas-Flow Proportions of the Boiler

Area through all flues, sq. ft.	10.61
Grate area, sq. ft.	91.3
Ratio—grate area to flue openings, sq. ft.	8.6
Hydraulic depth of all flues, in.	4.27

As delivered, the railroad felt that steaming required more careful attention to firing than was desirable and, therefore, experimented with various stacks, nozzle diameters, diaphragm and table-plate arrangements.

All nozzles were of the 5- or 6-point star type and their area was changed by varying the width of the outer edge of the slots. Two 5-point exhaust nozzles with an area of 43.1 sq. in. were finally selected.

The locomotive has separate exhaust stands for each pair of cylinders. They are connected together. As the steam for the feedwater heater is taken from the rear cylinder exhaust, a smaller exhaust tip was tried in the rear exhaust stand to compensate for this but showed no advantage.

Originally each exhaust stand had a separate 19-in. stack. Two 21-in. stacks were tried, the spacing between them varied, and the two 19-in. stacks joined to form one oval stack. None of these changes showed marked improvement, but the oval stack was finally adopted as it is an easier casting to make and weighs less. A 6-in. radius on the bottom flare gave the gases an easier entrance into the lift pipe than the original 1¼-in. radius.

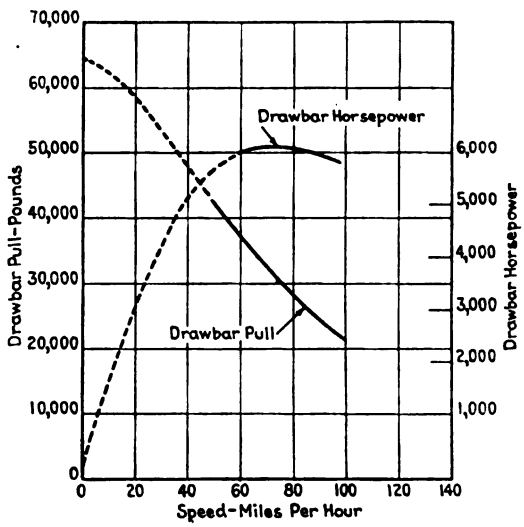


Fig. 7—Drawbar pull and drawbar horsepower corrected for a water rate of 100,000 lb. of steam per hour

The "cinder-buster" type of front end in addition to diaphragm and table plate of the conventional type, has a vertical baffle at the front of the table plate with an open space in front of the baffle between it and a sheet of netting at the extreme front of the smokebox.

Fig. 1 shows the drafts taken at different locations to show the loss through the several parts of the boiler. It will be noted that at normal rates of firing—i. e., 150 lb. per sq. ft. of grate area—the draft is 15 in. of water and that the greatest draft required is through the flues at all rates of firing.

The table-type grate bars are 9¾ in. wide with $136\frac{11}{16}$ in. square holes on a side, giving an area with the openings between bars of 14.93 sq. ft., or 16.4 per cent of the total grate area for air admission.

The Test-Plant Results

Tests were made at speeds of 38, 57, 66, 76, 85, 95, and 100 m.p.h. and at various cut-offs from 10 to 50 per cent, with full throttle, and there were various other miscellaneous tests run for special purposes.

Coal used was a high-volatile, run-of-mine, Westmoreland County, with all slack under ¾ in. screened out. Its calorific value was 14,123 B.t.u. and ash content 7.58 per cent.

The only specific requirement given the railroad when placing the order for these two locomotives was that they should be capable of hauling a train of eleven 80-ton passenger cars at 100 m.p.h. on level tangent track. Based on the Davis formula for train resistance, this requires a drawbar pull of 11,200 lb. In service the locomotives have considerably exceeded this requirement, having hauled 16 cars at an average speed of 100 m.p.h. over typical stretches of road. Test-plant records show such performance to be easily possible, a cylinder tractive force exceeding 25,000 lb. having been obtained at 420 r.p.m. (100 m.p.h.), which is considerably more than required to haul the locomotive and a 16-car train.

The calculated evaporation, based upon the Baldwin 80-lb. rule, including feedwater heater, is 82,000 lb. Actually, this has been greatly exceeded, a maximum of 105,475 lb. having been obtained on the test plant. Road performance also shows that the calculated evaporation is being consistently exceeded in service, which can be credited to the large furnace volume which supports a high rate of combustion.

Boiler Performance

Steam temperatures were taken in the header to the front and rear cylinders where it joins the steam pipe leading from the superheater header. Fig. 2 shows these temperatures at various rates of firing, compared with the temperatures of the smokebox gases. The high degree of superheat obtained at even relatively low rates of evaporation is outstanding. This is interesting as it is being obtained with a single-loop Type A superheater.

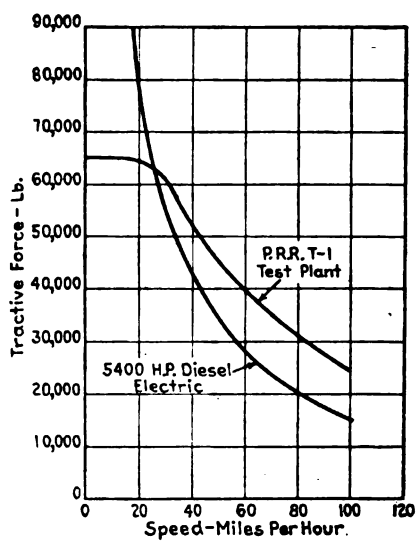


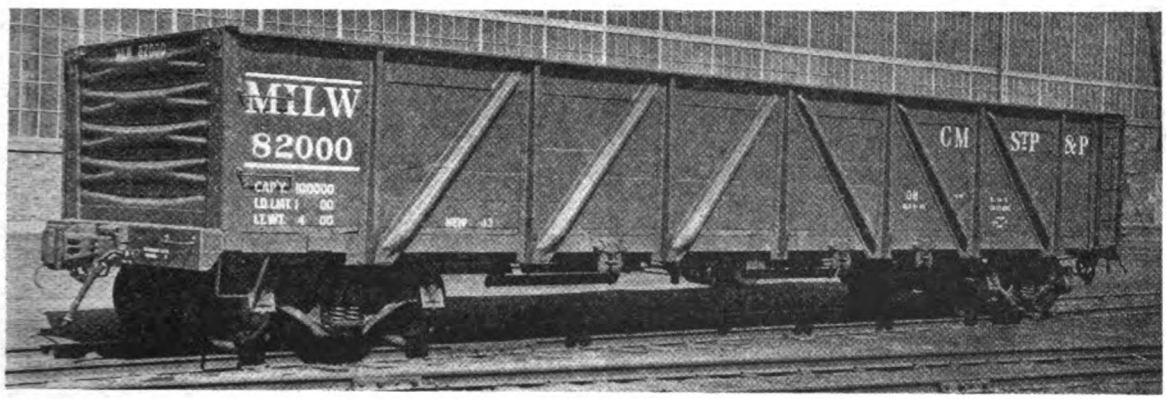
Fig. 8—Tractive force of the T-1 locomotive compared with that of a 5,400-hp. Diesel locomotive

The maximum capacity of the boiler was found in a test at a speed of 100 miles per hour, full-throttle, 20 per cent cut-off, and a firing rate of 252.2 lb. of dry coal per sq. ft. of grate area per hour. The evaporation in this test was 105,475 lb. of water per hour.

The efficiency of the boiler and furnace at various rates of firing ranges from 65.5 per cent when burning 50 lb. of dry coal per sq. ft. of grate area to 43 per cent when

(*Continued on page 292*)

Fabrication of Gondolas*



Composite gondola built at Milwaukee shops

50-ton all-purpose composite gons are built by welding at the Milwaukee shops – Production is eight cars a day

THE Chicago, Milwaukee, St. Paul & Pacific has pioneered in the development of all-welded cars, both freight and passenger, and in the last ten years has designed and constructed at its Milwaukee, Wis., shops about 250 lightweight passenger cars, and over 12,000 freight cars of various types.

Of the recent groups of cars constructed, 735 composite gondola cars were designed to carry all manner of loads—bulk sand, gravel, coal, pipe, steel shapes, plates, etc. Classified as all-purpose utility gondola cars, they average around 44,800 lb. and were turned out at the rate of eight cars a day, or one each hour in a car shop arranged to stress flexibility of production layout.

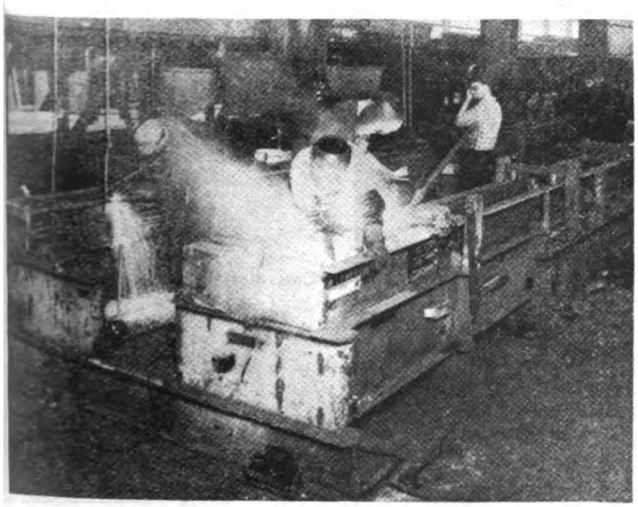
Frames were constructed almost entirely by welding, following an accepted standard design. Car sides and floor were of wood. Utility features incorporated in the car design included six hinged drop doors in the floor, operated manually from the side.

This accomplishment was not without precedent in the Milwaukee shop, where ever since 1934 freight cars have been constructed by position-production methods employing erection lines supplied by subassembly flow lines. Year by year new economies—savings in labor and materials—have been realized through increasingly efficient use of the techniques of all-welded construction.

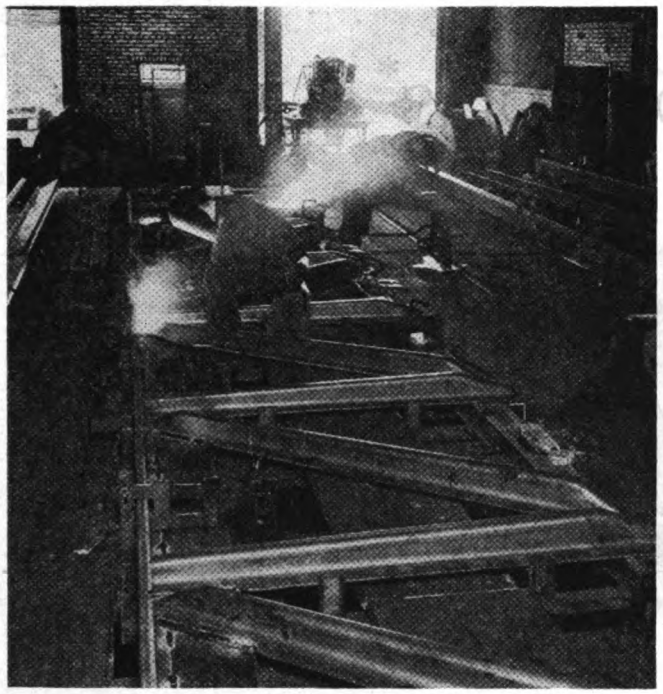
High strength, durability and weight saving are primary objectives of Milwaukee construction methods. It was in this shop that the first lightweight passenger car on the Milwaukee was constructed in 1934. This car, 30,000 lb. lighter than its predecessors, has proved many times over in ten years of continuous service to be equally successful from the standpoints of both operation and maintenance. During the intervening years great improvements were made in welding procedures, designs, and construction of jigs for both passenger and freight cars. As a result, further weight savings were achieved along with higher utility and facility of construction, all without any sacrifice of necessary strength in the finished car. An important part of the saving in weight, it should be mentioned, is achieved through the use of low-alloy steels in place of plain open-hearth steels.

As an illustration of the possibility of savings in weight reduction, the 50-ton, 40-ft. 6-in. and the 50-ton, 50-ft. 6-in. box cars, built at this shop, netted a weight saving over the conventional car up to 4½ tons a car, and at the same time produced a box car that was wider and higher and had greater cubic capacity than any other car built in the country within A. A. R. clearance limitations. Statistical data has been developed indicating that for each ton of weight reduction made in a freight car, a minimum saving of $12 per car per year

* Information presented in this article was compiled by representatives of the Milwaukee mechanical department and of the Air Reduction Sales Company which supplied all photographs except that of the finished car.



Welding of center sills supported on jig positioners



Side-frame assembly—Note the shop-made hold-down clamps on this jig

can be effected. For passenger cars which make about ten times the yearly mileage of a freight car, the savings are calculated at $120 per car per year for each ton of weight reduction.

With the all-welded type of construction, fitting-up of parts to the various assemblies requires simple jigging and, therefore, only a minimum of mechanical skill, an important and somewhat rare commodity. The same applies largely in the fabrication of parts, inasmuch as this fabrication consists for the most part merely in using steel structural plates, sheets, bars, etc., purchased to the most economical mill tolerance and then sheared or cut with an oxy-acetylene machine.

Plate up to 5/8 in. is used and electrodes up to 5/16 in. in diameter. At junctures of important stress points, deep fillet and vertical welding are employed.

Selection of arc welding equipment has kept pace in the shop with developments such as the trend toward larger electrodes and higher welding heats. Also, wherever possible, simple positioning devices have been installed to insure the best work from operators whose ability in flat or downhand welding may not be matched by proficiency in welding in the horizontal, vertical and overhead positions. For the most part, the shop is equipped with 300-amp. welders which are considered best for this work, although a few smaller and a few larger capacity machines are also used. The 3/16-in. diameter electrode is the size most commonly used.

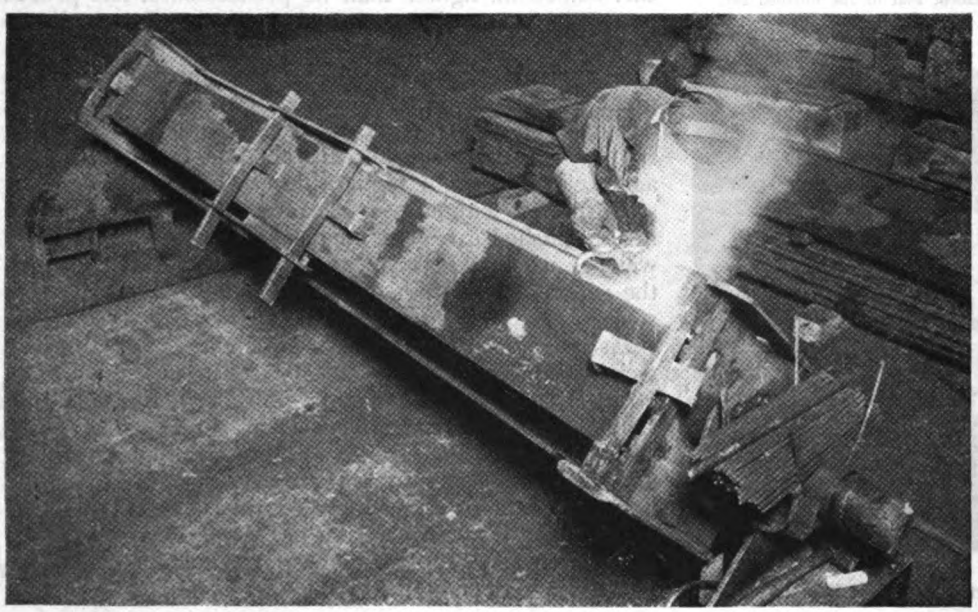
Two Erection Lines

The shop production plan involves two erection lines with subassemblies feeding in. The cars move along the line in scheduled progression from one specialized erection position to another. Adequate time is allowed

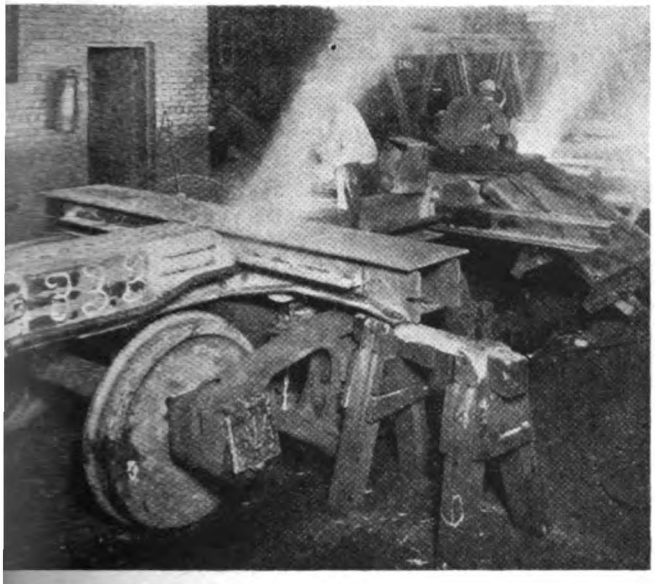
Drop ends are assembled on a table-size jig—Ends drop inward from hinges at the bottom

for the orderly distribution of material and men to each position.

The erection lines are two parallel stretches of standard gauge track. Beside them run other supplemental lines inter-connected by switches strategically placed to insure steady production flow over the entire network. After initial fabrication work is completed, prefabricated sections are stacked at appropriate positions alongside the first erection line. Here the bulk of the actual heavy construction work is completed before the car rolls onto the next erection line to receive wooden flooring and undergo various finishing operations.



Cross-bearers tacked and welded on rotating positioner



Underframe assembly is welded on the trucks at the head of the assembly line

Construction of the Cars

As shown in an illustration, center sills are arc welded on two sturdy jig-positioners close beside the erection line. At this stage they are welded on only one side. Then holes are cut with a hand torch in A.A.R. Z-26 center-sill sections 12⅞ in. deep, and the sections are assembled with center filler, striker, draft gears, air cylinder, lever guides, slack adjusters and couplers.

Assembly of center fillers is facilitated by use of a positioner and alignment frame which allows easy and unlimited repositioning of the work so that the operator may have ready access to all weld areas and may do the entire job by downhand welding. Before the war, cast center fillers and strikers were used, but with the increased scarcity of cast steel, a welded substitute which has proved satisfactory was designed. Principally built up from plate sections, it still includes one small cast portion and thus stands out as an interesting example of the potentialities of combined cast and welded fabrication.

Cross bearers are tacked and finish-welded on a combination jig and positioner consisting mainly of a long trunion-mounted horizontal shaft. The work is repositioned by rotation of the shaft while the side, top and bottom plates are held in correct alignment by saddle and wedge jigging devices. Bolster assemblies are welded on a rotating shaft positioner very similar to this.

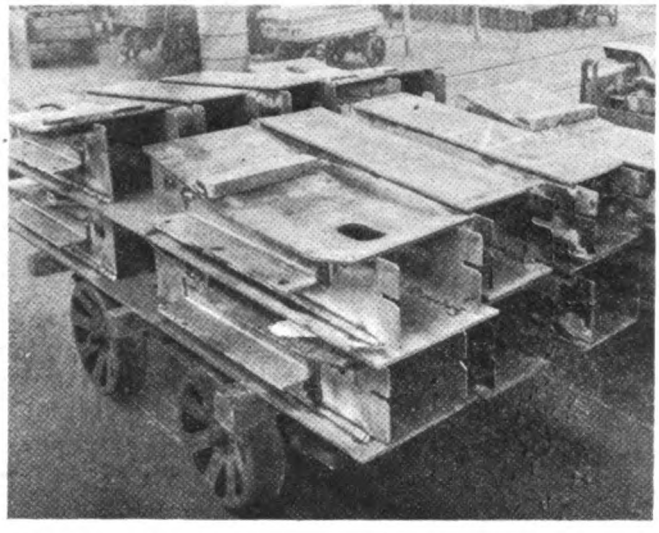
Fabricated car parts are stacked on sturdy low-slung trucks and wheeled to positions on the erection line. Lighter subassemblies and additional material are moved on lighter trucks like those in the background of one of the views.

Drop doors are fabricated by welding on special positioners. Included in their assembly are a door base plate, Z-iron stiffeners and a T-iron catch to engage with the door locks. The T-irons are produced by slitting at the steel mill or in the shop by cutting with an oxy-acetylene machine torch.

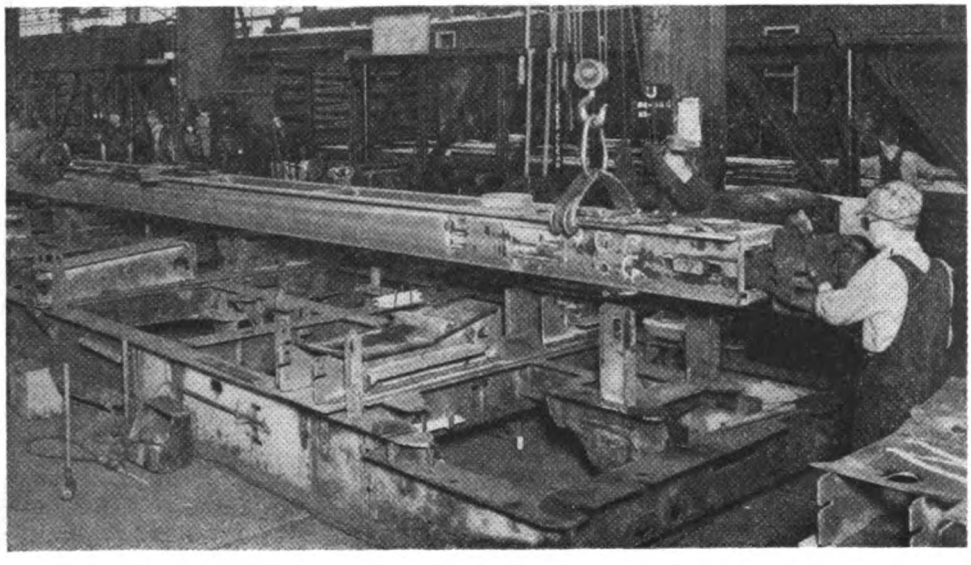
Provision for Contraction

No special effort is made to prevent distortion in many of the subassemblies. In some instances jigs are designed with the deliberate intention of introducing a slight camber into the assembly. This camber acts as compensation for subsequent contraction of the welds, thereby eliminating distortion in the finished part; however, in welding heavy material this is not necessary.

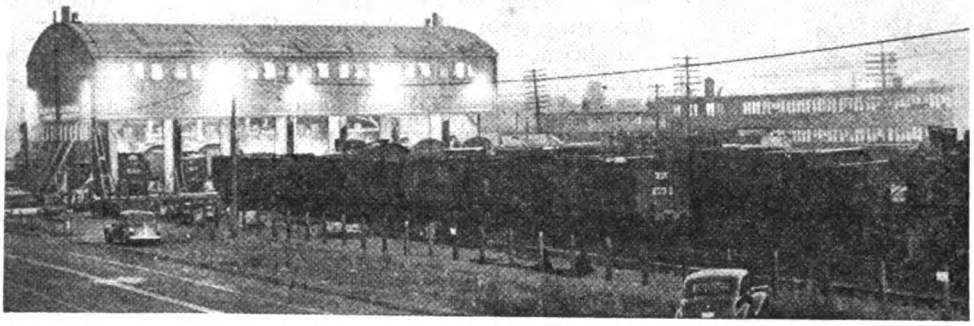
(*Continued on page 291*)



Fabricated car parts are carried to erection line on hand trucks—On the truck in the foreground are bolsters and cross-bearers

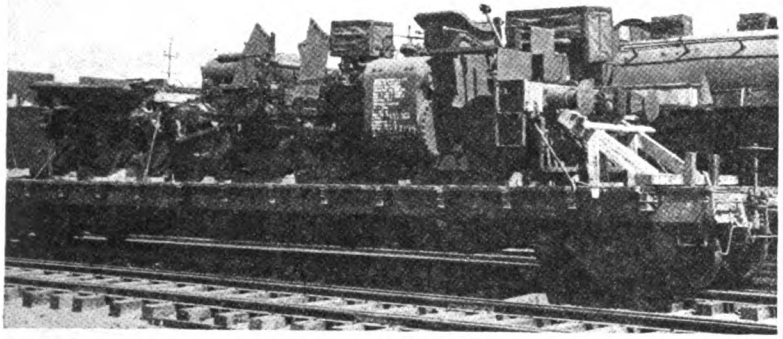


Uprights on underframe hold parts of first major assembly in line for welding

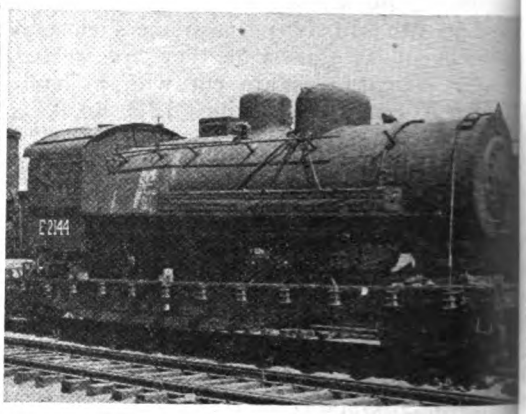


The locomotive shop and the yard for the storage of assembled locomotives

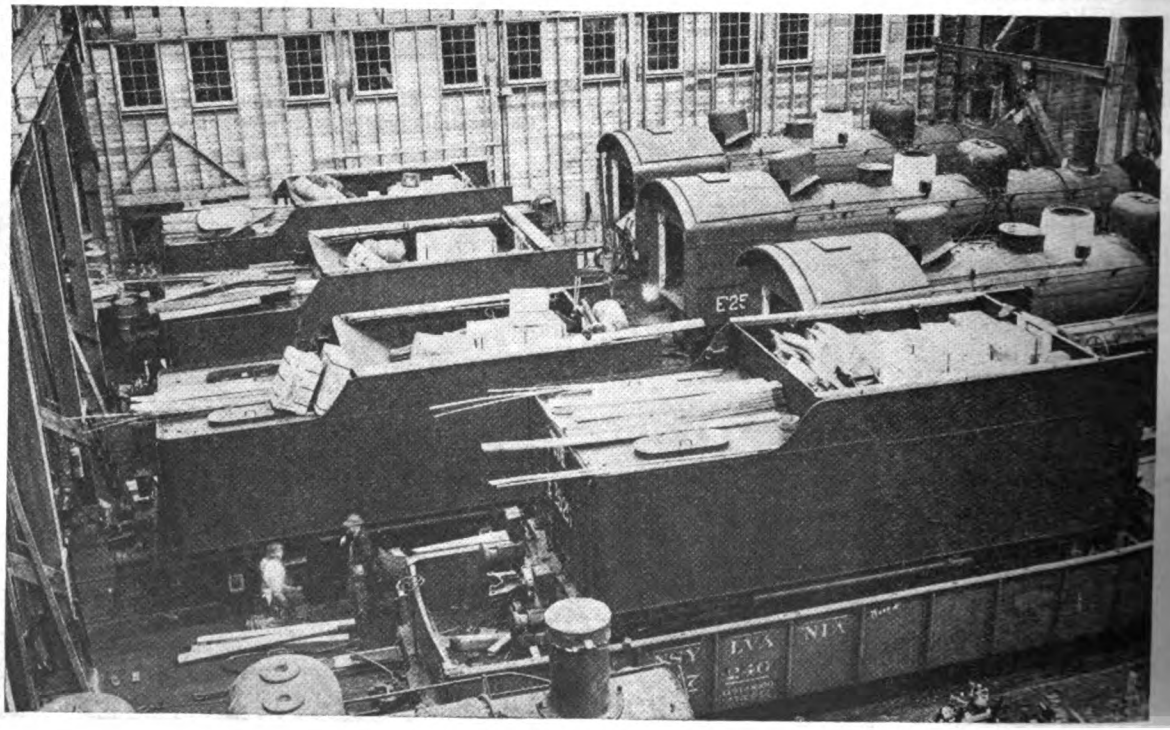
Assembling Russian Locomotives



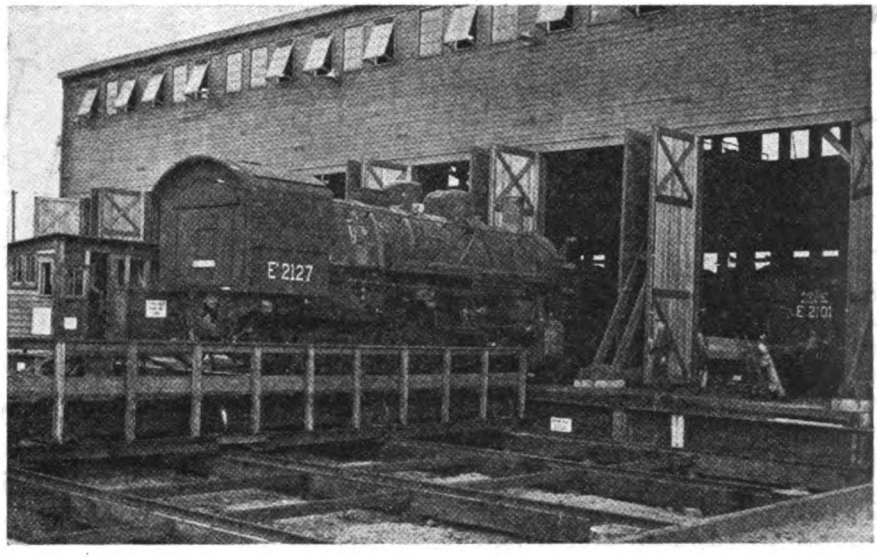
The boiler section as received from the builder's plant

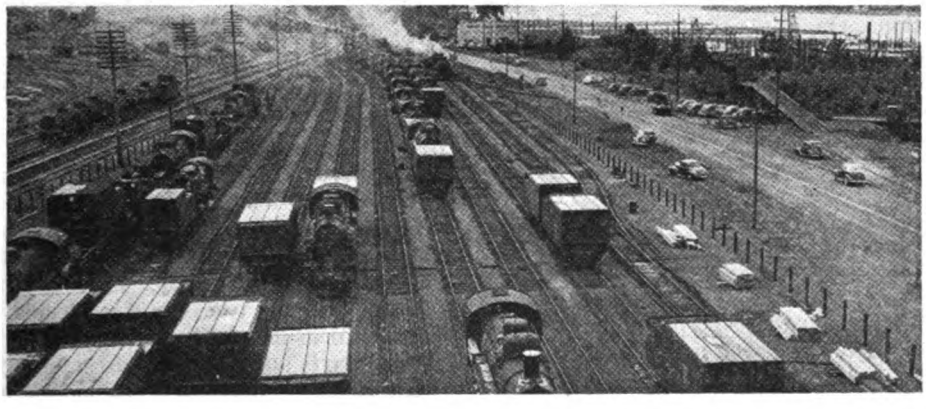


Above: How the frames and running gear of the Russian 2-10-2 locomotives are received from the builders — Below: The shop interior



THE District Transportation Office of the U. S. Army operates this plant at Portland, Ore., for assembling Russian 2-10-0 locomotives preparatory to loading them on shipboard in the Columbia River. The locomotives are received from the American Locomotive Company and the Baldwin Locomotive Works. All photographs are from the U. S. Army Signal Corps except as otherwise noted.





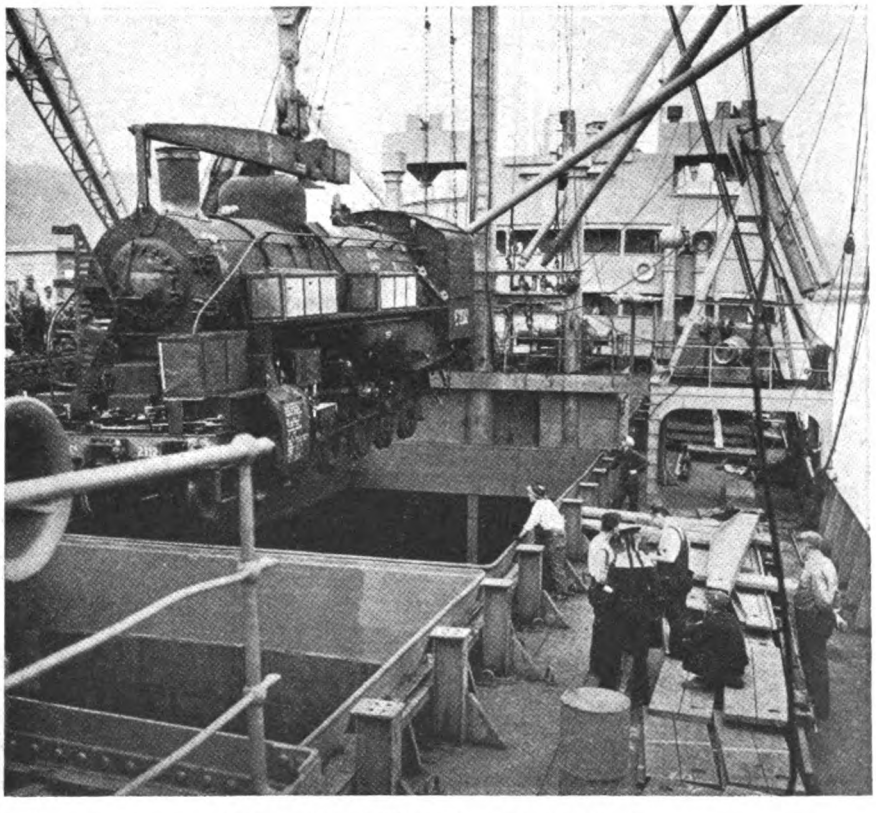
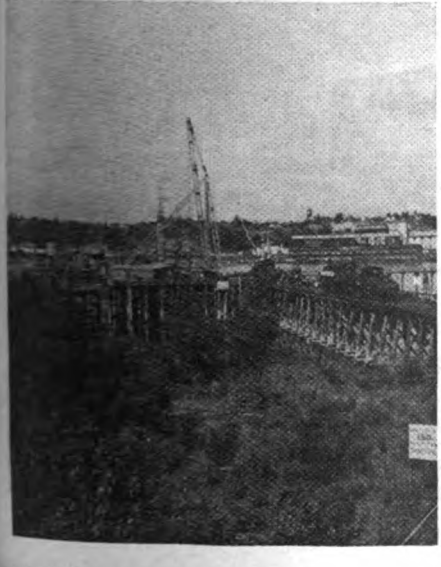


Photo courtesy of Willamette Iron & Steel Corp.

Top: A completely assembled locomotive moving out of the shop to the transfer table—Center: From the transfer table the locomotives and tenders are moved into the storage yard—Below: The trestle leading from the yard to the loading dock—Right: This locomotive will soon be secured in the hold



Use of Metallic Arc Welding in

Fabricating Pressure Vessels*

By Charles M. Scudder† and John J. Chyle†

Many steps in building of unfired vessels by welding applicable to locomotive boilers – Good engineering and shop practice essential

THE development of the welding process, with respect to the construction of pressure vessels has advanced to such a state that the great majority of all pressure vessels built today are of welded construction. This development of the welding process originated with the building of oil refinery vessels. The first metallic arc welded pressure vessel for the oil industry was fabricated by the writers' company in 1925.

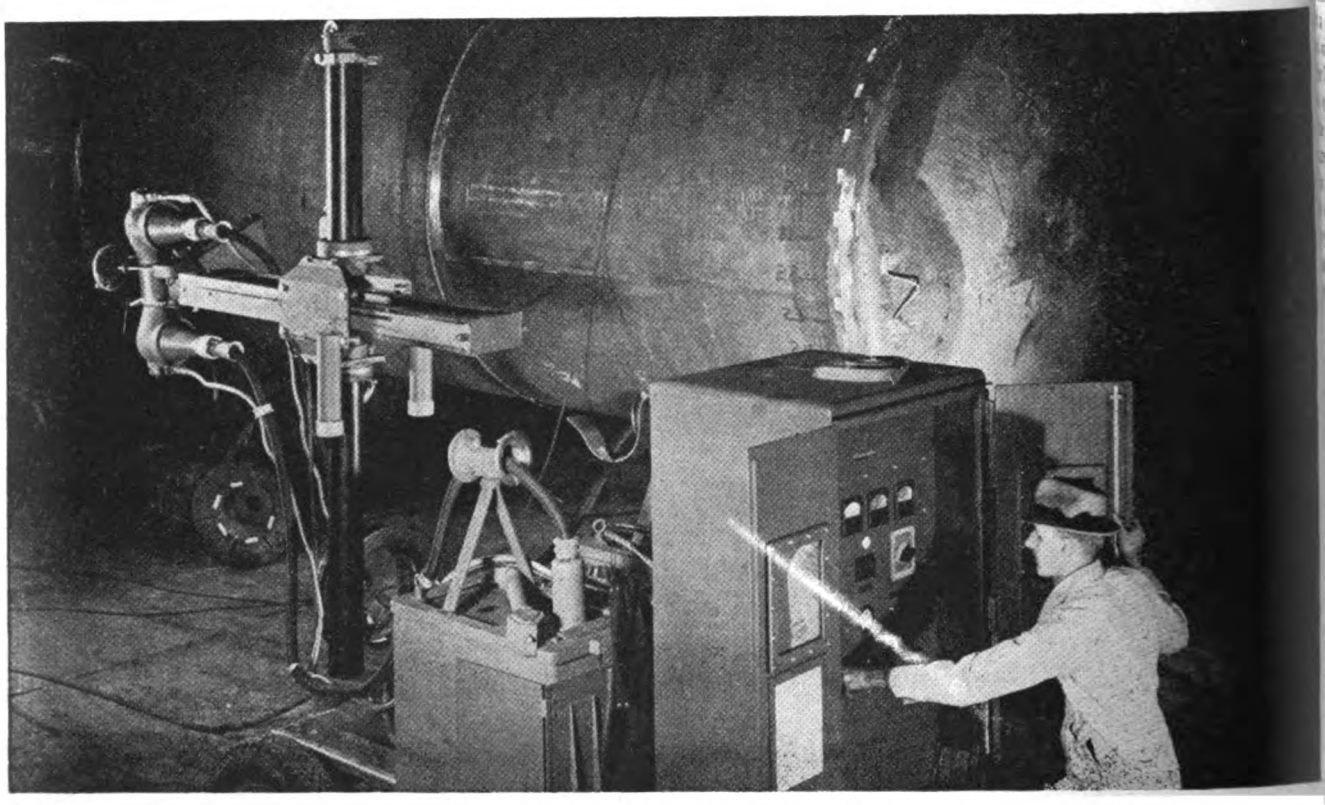
By the beginning of 1925, the oil industry was becoming very much concerned over the safety of its pressure vessels. Riveted and forge-welded vessels were proving absolutely inadequate for such service. Two major accidents at this time, involving considerable loss of life and property emphasized the need for drastic changes in pressure-vessel fabrication. The impossibility of keeping riveted vessels tight under the conditions of wide temperature and pressure fluctuation imposed, created a fire hazard of a most serious nature. The process of forge welding was not developed to a point where consistently high quality forge welds could be obtained. Adequate inspection methods were not available at that time to detect inferior workmanship.

Our company was a pioneer in the development of coated electrodes which produced ductile weld metal suitable for pressure-vessel welding. The coated electrode was initiated in 1917, and by 1925 the process of producing sound and ductile welds had been proved. Based upon this development the first metallic arc-welded oil cracking still was shipped to the Texas Company in July 1925.

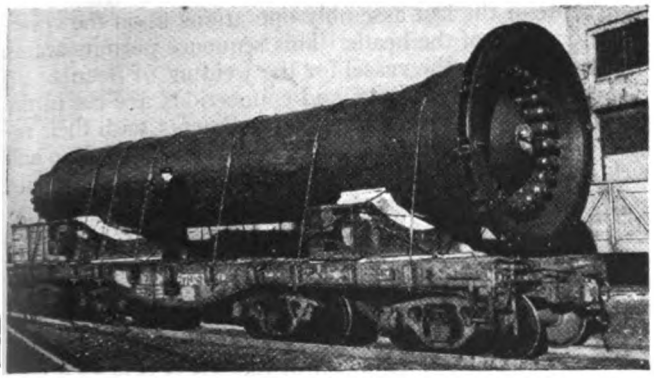
Although the problem of producing high-strength, ductile welds had been solved, it was soon realized that certain elements of construction such as heads, manways, nozzle connections, etc., were improperly designed. This fact was emphasized through the subjecting of all-welded vessels to much higher pressure tests than had been possible with riveted vessels. To solve these problems adequately, full-sized vessels were tested to destruction and various measures taken to determine the behavior of the critical parts and points where modification or reinforcement appeared necessary. Economic and efficient design demands that all parts of a vessel have approximately the

* A paper prepared for the 1944 proceedings of the Master Boiler Makers' Association.

† Engineers, A. O. Smith Corp., Milwaukee, Wis.



Welded seams are X-rayed to disclose defects



This large high-pressure accumulator was fabricated by welding

same factor of safety. In order to obtain the information necessary to produce such a design, some 23 full-sized vessels were tested to destruction by our company. As a result, present-day all-welded designs are well balanced as to the factor of safety of the various parts.

For a great many years all types of pressure vessels have been the subject of regulations concerning their construction to insure safety. One of the early groups considering such matters was the A. S. M. E. Boiler Code Committee which wrote a code covering riveted and other contemporaneous types of construction as applied to steam boilers. The all-welded pressure vessel fell outside of any code regulations at the time of its inception and remained outside of the codes for a considerable period due to the hesitancy of the code bodies to approve metallic arc welding. Other groups having to do with the public acceptance of pressure vessels, such as the Interstate Commerce Commission and some of the insurance companies, were also very slow in accepting metallic arc welded construction and in recognizing its advantages.

As the A. S. M. E. Boiler Code was primarily written for steam boilers, its early regulations did not adequately cover refinery vessels. Therefore, the American Petroleum Institute in co-operation with the A. S. M. E. developed a code designed primarily to apply to such vessels and which is now known as the A. P. I.-A. S. M. E. Code for Unfired Pressure Vessels. At the present time, the two codes call for a factor of safety of four, based upon the minimum tensile strength of the steel. Welded joints are assigned efficiencies varying from 80 to 95 per cent for fully penetrating butt welds. A definite procedure is outlined for qualifying welders and for the procedure to be used in pressure-vessel production. These two qualification requirements constitute very important steps toward insuring reliable welds.

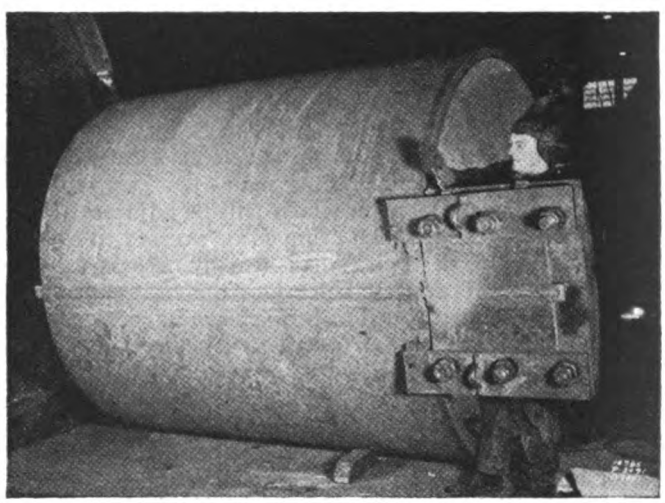
Making High-Quality Welds

The production of a high quality weld depends upon many factors, the principal ones being: the electrodes; skill of the welding operators; the plate material; and the welding procedure.

The development of electrodes today has been such that a great variety of different types are available for specific applications. It is necessary to select the electrode which will give the desired physical and chemical properties to the finished weld. The electrode should also be selected upon the basis of the type of welding to be done, such as downhand, horizontal, vertical, etc. The American Welding Society in conjunction with the American Society for Testing Materials has issued specifications covering the various types of electrodes accepted today.

The high quality of welding required on pressure vessels makes it mandatory that only experienced operators be employed. The operator should be qualified under the operator qualification tests which are specified by the A. S. M. E. or other codes. It is also important that his past experience be sufficient to enable him to correct unusual conditions encountered during welding operations. For important work, we must depend upon the welding operator to report pecularities and irregularities which an inexperienced operator might overlook, attributing any difficulty encountered to his own inexperience. Where automatic welding is used, it is also necessary to have an experienced and qualified operator in charge.

The specification for the steel plate to be used should be chosen with due regard for weldability as well as physical and chemical adaptability for the job to be done. The weldability of steel plate is dependent primarily upon its chemistry and cleanliness. Under present day conditions, the steel plate may contain excessive residual elements due to the character of the scrap used in its production which might have a marked effect upon the weldability of the steel. For high-strength steels, it is necessary to employ preheating for the welding. The effect of dirty or laminated steel will be to produce defects in the weld metal. These defects, in some cases, can be detected by X-ray examination. If the amount of defects encountered is excessive, a great deal of repairing will be necessary.



Weld test plate attached to shell

Steels are normally purchased under one of the A. S. T. M. specifications.

The welding procedure represents the best judgment of those in charge as applied to a particular welding problem and should be specified by a welding engineer. The welding procedure will specify the type of electrode, the diameter, the welding current, the degree of preheat, the design of the welding groove, and the welding technique to be employed. The welding engineer will also specify the amount and character of peening, the type of welding current, whether a.c. or d.c., and also the heat treatment after welding.

The A. S. M. E. Code requires that the welding procedure be qualified by making a test plate with the proper welding procedure and subjecting the test plate to certain tests. Additional information on the procedure is obtained by the testing of the test plate or plates made in connection with the construction of the vessel. Any deviation in manufacturing procedure requires a new procedure qualification test to confirm its adequacy.

The fabrication of high-pressure vessels of welded construction is similar, regardless of whether it is intended for the oil industry, for the production of high-pressure steam, or for chemical or other purposes. Vessels for oil-refinery service cover a wide range of overall dimen-

sions and wall thicknesses. They may be designed for very high- or low-temperature conditions or for severe temperature cycles. Lengths of 150 ft. or more, diameters in excess of 40 ft. or wall thicknesses of over 4 in. are not uncommon. Temperatures may range as high as 1,000 deg. F. for certain services and pressures of 750 lb. per sq. in. are common.

For accumulators and vessels connected with synthetic ammonia plants, pressures of 5,000 lb. per sq. in. are in continuous use. For these last two types of vessels, the multi-layer construction is frequently employed. There is no reason why welded vessels should not be used for pressures considerably in excess of 5,000 lb. per sq. in. if properly designed.

Manufacture of a Pressure Vessel

Many towers for oil refineries are in the neighborhood of 70 ft. long, 8 ft. in diameter with a wall thickness of 1¼ in. The following outline covers the manufacture of such a vessel, the steps listed being the same as would be involved in the production of practically any solid-wall vessel by metallic arc welding.

Steel plates are purchased to some standard specification, such as A. S. T. M. A-70-39. The plates are inspected at the mill and physical and chemical tests are made to insure conformance to the specifications. The first shop operation upon the plates is to plane or scarf the edges to give the desired groove contour for welding. Gas cutting of scarfs is also employed on thin plates or for special automatic welding. Four sides are usually scarfed while the plate is in the flat to take care of both longitudinal and circumferential seams.

The two ends of a plate which will be adjacent to the longitudinal seam are then crimped or pressed to the approximate radius desired. This is usually necessary as the rolling operation cannot take care of the extreme ends of the plate. It is next rolled to form the cylindrical section, and the edges are tacked together. The section is then ready for welding.

For manual metallic arc welding in which a U-groove seam is used, the welding is generally performed from the outside first. After this weld is completed, the interior lip edges are chipped away until sound weld metal is reached. Welding is then done from the inside to completion. All details of the welding of longitudinal seams must conform to the procedure which was set up by the welding engineer. Test plates are attached to the shell so that the test plate weld is a continuation of the longitudinal seam. The checking of the procedure by the testing of these plates represents an essential control as provided by the Codes. The number of such plates is governed by the total length of seam welded. Subsequent to the completion of the weld, the shell is re-rolled to give it a uniform radius. In the case of thick plates, both the rolling and re-rolling must be done with the plates heated.

Heads for pressure vessels such as are described here, are generally of the semi-elliptical type in which the head is of about the same thickness as the shell and is designed for the same working stresses. Such heads are pressed, spun, flanged or forged depending upon the material, diameter and thickness. The proper scarf is machined upon the head after it has been formed. Openings in the head are usually gas cut or machined out with possible subsequent grinding to clean the scarf thoroughly. Manways, nozzles, etc., are now welded in place in the heads with the appropriate reinforcing collars.

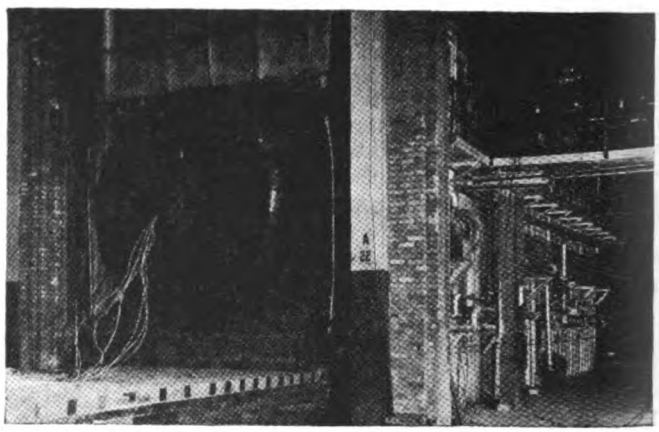
The vessel is assembled by joining the individual shell sections together, utilizing rollers so that they may be rotated to facilitate the welding of the circumferential seams. All of the welding of the circular, as well as the longitudinal seams is performed in the downhand position. One of the last assembly operations upon the vessel is the hanging of the heads. This sequence permits access to the interior of the vessel for the welding of details.

The holes for manways and connections are cut in the shell, the edges scarfed and the attachments with their reinforcements welded in place. The proper scarf fitup and welding sequence is very important in assembling details.

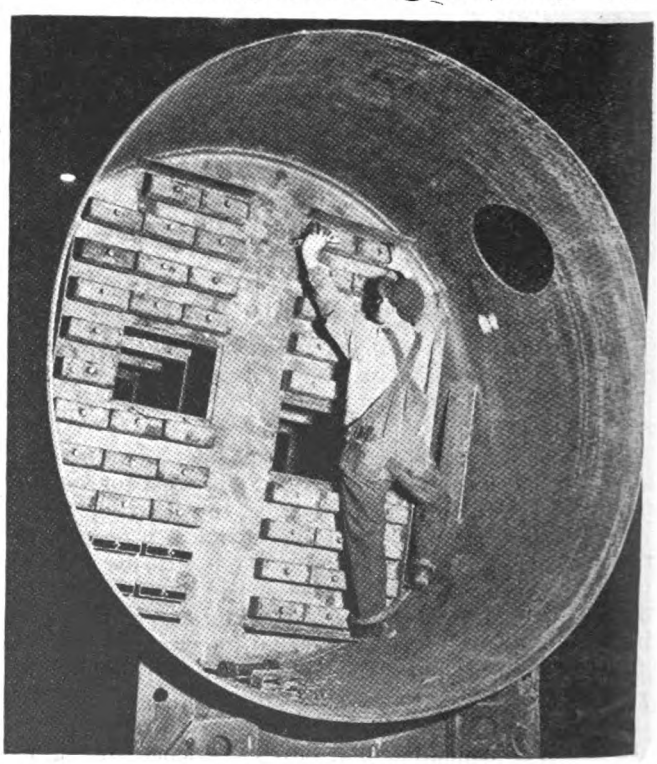
With the welding completed, the stress-relieving operation is next in order. The vessel is usually supported under the two heads. It is brought up to a temperature of approximately 1,150 deg. F., held for one hour per inch of wall thickness and then allowed to cool in the furnace slowly to 600 deg. F. It is then removed and allowed to cool in still air. The object of the stress relieving is to remove the stresses which are set up in the vessel due to the welding operation. While no metallurgical change is involved in the metal by the stress relieving temperature used, there may be a slight reduction in the tensile properties of the steel due to the treatment given.

Test Procedures

On high-pressure vessels, X-ray examination of all the main seams is mandatory by the codes and this non-de-



Stress relieving furnaces are used after welding



Installing internals in a refinery vessel

structive method of examination has proved to be an important factor in the control of the quality of the welds. The X-raying of all of the major seams of the vessel may be done either before or after the stress relieving operation, a record being made of the location of all exposures. Defects which are revealed and which exceed the standards fixed by the codes or rules in force are removed by chipping, and are re-welded and re-X-rayed. Major repairs necessitate another stress-relieving operation with subsequent examination by X-ray.

The final operation consists of subjecting the pressure vessel to the hydrostatic-pressure test fixed by the vessel specifications. Under the A. S. M. E. Unfired Pressure Vessel Code, the test pressure is set at twice the working pressure. The vessel is subjected to the pressure for at least one hour during which all welds are carefully examined for evidence of leaks. A hammer test of the welds may also be made at a somewhat reduced pressure. In this test, a hammer of definite weight is used and blows are struck at intervals on the weld seams. A chart record of the test pressures may be supplied the purchaser as a part of the vessel record. At the successful conclusion of this test, the vessel is stamped with the required data and prepared for shipment.

It is the usual practice for the purchaser to have his own inspectors or an insurance inspector present during the final acceptance test and also during certain stages of the fabrication. Both the codes and the insurance companies request the certification of the pressure test by a qualified inspector. This gives the purchaser or the user of the vessel an independent inspection assuring that the provisions of the codes or applicable rules, have been carried out.

This discussion of the fabrication of a pressure vessel refers chiefly to manual metallic arc welding. Variations of the procedure are necessary when mechanical welding equipment is used, when combinations of manual and mechanical welding are adopted or when multi-layer vessel construction is involved.

Welding Locomotive Boilers

The problems encountered in the fabrication of the cylindrical section of a locomotive boiler by welding would be quite similar to the problems which have already been studied and successfully solved in the pressure vessel field.

Due to the present design of locomotive boilers, consideration must be given to the special features of firebox design. These involve the staying of flat surfaces and the reinforcement of irregular shapes, subject to severe thermal changes and flame impingement. The supports and vibration of the boiler in service will require careful study. Welding data which have been accumulated in connection with the study of other structures and machine elements can contribute largely to the solution of these problems. in the last analysis the process of joining the sections, the materials to be used, and the welding procedures involved should closely follow those developed for pressure-vessel metallic arc welding.

Assembly Line Fabrication of Gondolas

(*Continued from page 285*)

Hangers for the drop doors are fabricated from T-irons and small flame-cut pieces of plate. They are welded on a metal skeleton table fitted with simple jigging blocks. No positioners are necessary here because the assemblies are simple, requiring little welding. The table top, however, was placed at convenient welding height for the average operator.

Underframe Jig Assures Accuracy

Elaborate underframe jigging arrangements lend speed and efficiency to the first major assembly operation. Exact alignment for welding is achieved simply by laying the constituent subassemblies where they fit in the jig. As may be seen in the illustrations, the underframes are assembled in the inverted position, the obvious advantage of this being that heavy underparts may be lowered onto the pre-aligned smaller subassemblies instead of having to be raised against them from beneath. Only the readily accessible welds are completed in this initial assembly operation. Not until the frame is reinverted is any attempt made to complete the welding on both sides.

The bolster and cross sills are first laid in position on this jig; then the center sill, which is the backbone on which all the other pieces rest, is lowered by crane between them. With all component subassemblies held securely in place between the jig uprights, assembly is completed easily and swiftly by a group of welding operators working as a team. To the center sill are attached bolsters, cross-bearers, cross ties, drop doors, reservoir tank and the AB brake valve. Underframe assembly as described is carried out on two such jigs simultaneously.

When completed, the entire assembly is lifted by crane and moved into position at the head of the first erection line, where actual car erection is begun. During this movement, it is turned right side up.

Resting partly on horses and partly on the trucks, the balance of the underframe is welded and is incorporated in a finished car foundation. The assembly is then ready to be rolled along the track to the next erection stage.

Side-Frame Fabrication

Assembling of side frames consists of welding a side plate to the top reinforcing chord (made from a regular bulb angle), then laying posts and braces across them to the bottom channel or side sill and welding the whole structure together. A staggered sequence without step-back is considered adequate for the weld joining side plate and chord. To hold the separate parts in position for welding, a jig with shop-made hold-down clamps is used.

The posts and braces also are fabricated in the shop. Rectangular pieces of plate are sheared or cut out with a Radiagraph and then formed into three-dimensional shape on a hydraulic press.

Side assemblies are swung into position on the car bodies and held firmly by heavy screw jacks which, when tightened, pull the bottom channel toward the center sill and into the grooves prepared for it in the ends of the cross sills. Fillet and lap welds fasten the bottom channel securely in these grooves.

Drop ends are assembled on a table-size jig. Corner posts of formed angle shapes are welded to the drop end gate, gussets, reinforcing top chord angle and end sills. These angle shapes, like the post and braces previously mentioned, are made by cutting out rectangular pieces of plate with a Radiagraph and bending to desired shape.

Attachments Welded in Place

Various other attachments welded into the assembly at this juncture include a bracket for a hand brake, supports for floor stringers, bracket for pin-lifter and end plate complete with hinges. The ends drop inward from hinges at the bottom. They are assembled at night and stacked

on special racks ready for car erection during the following day.

With car-frame erection completed, the wooden blocks between sill bolsters and trucks are removed, allowing the gondola to settle on its trucks. The blocks were inserted earlier to provide welding space between trucks and gondola. The car is now ready to receive its wood sides and flooring which are bolted in place.

On the second and last erection line, carpentry takes up where metal fabrication leaves off. This line bears a closer resemblance to an automotive assembly line. At one stage flooring is laid in position, at the next it is bolted, at a third it is tightened. In the same systematic way the siding is put on. Finally, step board and safety appliances are added and after a final inspection, paint is sprayed on and a finished car rolls off the line.

Test Plant Tests Pennsylvania T-1 Locomotive

(*Continued from page 282*)

burning 240 lb. per sq. ft. of grate area. Fig. 3 shows the heat balance plotted against various rates of firing. As in all locomotive boilers the largest heat loss is that due to fuel escaping unburned. At the highest firing rate, where the boiler efficiency is 43 per cent, the loss due to unburned coal is 44 per cent. However, the locomotive is rarely worked at this rate and then only for short periods.

Fig. 4 shows that the heater saves from 5 to 11½ per cent of the water, depending upon the rate of evaporation, thus, in effect, increasing the capacity of the tender.

This locomotive shows remarkably low pressure drop from the boiler to the steam chest, the maximum obtained being only 9 lb. at maximum evaporation. Fig. 5 shows the pressure loss at various rates of steam use, distributed for the dry pipe, superheater, throttle, and steam pipes. These pressures were measured with a mercury manometer.

Engine Performance

The steam per indicated horsepower hour at various speeds are shown in Fig. 6. The minimum water rate was 13.6 lb. at a speed of 76 m.p.h. and 20 per cent cut-off. In most of the tests the water rate was between 14 and 15.5 lb.

In 40 years of testing on the Altoona test plant, this locomotive gave the lowest water rate. In looking over these records it is interesting to note that after superheating came into use the improvement in water rate has only been about 8 per cent in 30 years and this is largely the result of increases in temperature and pressure of steam supplied to the cylinders.

Likewise, the maximum indicated horsepower of the T-1 locomotive is 40 per cent higher than that of any locomotive previously tested at Altoona. The maximum indicated horsepower of the T-1 locomotive on test was obtained under the conditions set forth in the table.

Conditions Under Which Maximum Indicated Horsepower Was Developed

Maximum i.hp.	6,552
Speed, m.p.h.	85.5
Cut-off, per cent	25
Boiler pressure, lb.	295
Steam-chest pressure, lb.	287
Temperature steam at steam chest, deg. F.	757
Steam to engine per hr., lb.	101,219
Steam per i.hp.hr., lb.	15.4
Total volume of cylinders, cu. ft.	35.92

The T-1 locomotive developed a maximum of 6,100 drawbar horsepower, which is 46 per cent more than that of any other locomotive ever tested on the Altoona test plant.

The principal reason for the low water rate of the T-1 locomotive when developing maximum power is that the design of the locomotive permits the maximum power to be developed at short cut-off. The ability of the locomotive to produce maximum power at short cut-off can be attributed to three factors: (1) high boiler pressure; (2) low pressure drop from boiler to steam chest due to large steam passages (this is equivalent to higher boiler pressure); (3) large admission valves due to four cylinders and poppet valves.

At very high speed the T-1 locomotive produced nearly maximum power at 15 per cent cut-off. To produce moderate power at high speed it is necessary to throttle the engine.

The machine efficiency of the T-1 locomotive is high due to the poppet valves and roller bearings on driving rods and axles. It was above 90 per cent at all speeds and horsepowers, with a high of 97.5 per cent at 38 m.p.h. and 4,500 hp.

Locomotive Performance

At low and moderate horsepowers the dry coal fired per drawbar horsepower-hour was generally below 2.5 lb. From 5,500 drawbar horsepower to 6,000 the coal rate rises from about 2.5 lb. to about 3.5 lb. Fig. 7 shows maximum drawbar pull and maximum drawbar horsepower based on a rate of 100,000 lb. of steam per hour.

The highest overall efficiency obtained was 8 per cent and the lowest 5 per cent. Except above a drawbar horsepower of 5,500 the efficiency was generally between 6½ and 7½ per cent.

An interesting comparison with the two-cylinder M-1-a locomotives of the Pennsylvania shows that the maximum drawbar horsepower developed by the T-1 locomotive was 46 per cent higher than the maximum developed by the M-1-a, although the steam to the engine per hour was only 11 per cent larger.

The T-1 locomotive was designed to haul a trailing load of 880 tons on level tangent track at a speed of 100 m.p.h. This requires a horsepower at the rear of the tender of 2,980. If wind and engine- and tender-truck resistances are deducted from the drawbar pull shown in Fig. 7, it is found that the T-1 locomotive develops 4,100 hp. at the rear of the tender at 100 m.p.h. which is about 38 per cent greater than necessary to meet the requirements. High points of the test are shown in a table.

These locomotives will out-perform a 5,400-hp. Diesel locomotive at all speeds above 26 m.p.h., as shown in Fig. 8, and if given comparable facilities for servicing and maintenance will do the work more cheaply. The disparity in Diesel and steam locomotive schedules is almost entirely attributable to coal, water and ash delays. With careful planning and the expenditure of only a fraction of the amounts spent in Diesel facilities, steam-locomotive servicing can be accomplished during the normal passenger stop. Coal chutes swinging lengthwise of the track and capable of dumping 43 tons of coal in 75 sec. have been installed. Likewise, water columns delivering 5,000 gal. per min. are in use. Hoppers capable of holding the full accumulation of ashes can be installed under tracks with sluices to wash them away. If such facilities are located at scheduled station stops, steam locomotives such as the T-1's can maintain schedules as fast as any demands impose.

An oil can bobbed with the waves caused by Sparks wading into the room

LOW HIGH LINE

By Walt Wyre

NED Sparks was on his way to the storeroom when he happened to notice the section gang preparing to go to work on the storeroom track. If the electrician had known at the time the headaches the gang of snipes was going to cause him, Sparks might not have greeted the section foreman quite so cordially, even though he knew the gang boss was only obeying orders.

"Looks like it needs fixing," Sparks said, meaning the storeroom track.

"Yeah," the section foreman replied, "but we're going to do more than fix it up; we're going to raise the track two feet and extend it towards the roundhouse six car lengths."

"Quite a job," Sparks commented casually.

That afternoon dump trucks began hauling dirt to build up the roadbed to raise the track, but the first load of dirt was not dumped near the storeroom, it was unloaded right in front of the electric shop.

"Say, what's the idea?" Sparks asked the truck driver. "I didn't order my front yard filled in!"

"Ask the division engineer," the truck driver replied good-naturedly, "I got my orders from him."

Sparks didn't ask the division engineer, that official not being handy, but he walked down near the storeroom and asked the section foreman, "Is the track going to extend as far as the electric shop?"

"Yep," the section foreman said, "that line of stakes is where the center of the track will be. The last stake is just past the edge of the electric shop."

"How high will the track be?" Sparks asked.

"Oh—let's see—'bout two feet at that end. It'll be more than that in the swag between here and that end. I disremember how much, but the figures are on the stakes," the section foreman added.

"Sure will be handy for me!" Sparks commented sarcastically, "having to haul motors and things over a track two feet high or else go around."

"Yeah, will be a little unconvenient," the section foreman said, "but I can't help it. I'm doing what the division engineer said do."

The section gang, although working shorthanded, finished the job of raising and extending the track in short order. Sparks talked to Jim Evans, the roundhouse foreman, and H. H. Carter, the master mechanic, about the track extension but both were too busy to pay much attention to what the electrician said.

THREE days after the track job was finished, it was raining when Sparks came to work. Sparks, slopping along with his head lowered, walked into the pool of water in front of the electric shop door before he noticed the fish pond. He swore, splashed on to the door and entered the electric shop. Then he swore some more. Water, backed up by the track fill and having to level out somewhere, had flowed into the electric shop and stood nearly shoetop deep on the floor. An almost empty oil can was floating around, bobbing with the waves, caused by Sparks wading into the room.

A boilermaker passing by yelled, "Hey, Sparks, how about fishing in your pond?"

Sparks went in search of the foreman to see about getting some laborers to cut a ditch for draining the water from the electric shop. While he was gone, some wag had chalked the word "hydro" above the electric shop sign on the door, making it read "hydroelectric shop." Sparks grinned a very weak and very wet grin, just using about half his mouth for the effort.

When a ditch was cut through the roadbed most of the water drained from the electric shop, leaving a coating of silt on everything on the floor, including Sparks' overalls that he had left on the floor when he peeled them off at quitting time the day before. Sparks wrung some of the water out of the sopping overalls, then carried them into the roundhouse and laid them on top of a hot locomotive boiler to dry. As he was climbing down from the locomotive, the foreman saw him and waited for Sparks to reach the floor.

"Been looking for you," Evans said. "The air compressor motor got so hot it was stinking. I shut it down."

"O.K.," Sparks said, "I'll go get my tools and look at it."

An odor of overcooked insulation and varnish pervaded the air around the 100 hp. motor and the frame was still so hot that Sparks couldn't hold his hand on it. Sparks checked the air gap to see if the bearings had worn and let the rotor drag. Air gap was O.K. all around. He next tested the fuses to see if one was blown, allowing the motor to run single phase. Fuses were all O.K. as were the contactor fingers when he looked at them. Then Sparks scratched his head. Maybe there was a loose connection at the motor, he thought. He removed the box cover and untaped the wires. All connections were reasonably tight and the lugs showed no sign of having been hot, so he retaped the connections and scratched his head again.

While Sparks was replacing the box cover, Evans came up. "Have you found what was causing the motor to heat?" the foreman asked.

"Not yet," Sparks told him, "and darned if I know just where to look now."

"Well, get it going soon as possible," Evans said. "Boilermakers have got a rush job on the 5061. The blacksmith forge is shut down and we sure need the air."

"O.K.," Sparks replied. "It shouldn't take very long unless the trouble is in the motor windings. I've looked at the fuses, motor connections, and contactors. Could be a loose connection in the starter." Sparks started removing the cover from the back of the controller cabinet.

Wires and connections looked O.K. and Sparks was ready for some more head scratching. He pulled at all of the wires that were soldered into lugs and found them solid, then felt of all the binding post nuts. They too were tight.

Sparks hesitated a moment, then decided to start the motor and see how it acted. When he pressed the button the motor came up to speed as usual, but when the running contactors closed the motor whined as though laboring with only one phase pulling. Almost immediately the hot motor smell that had almost disappeared was again evident and Sparks pushed the stop button.

"Where you going?" Evans asked when the electrician started to walk away.

"Going to the electric shop to get an ammeter," Sparks told the foreman and kept on walking.

When Sparks returned carrying the split core meter he again started the motor and hooked the meter over each of the wires in succession. The meter indicated no current in one of the wires and Sparks was still puzzled.

"Now where you going?" Evans inquired with a trace of irritation in his voice when the electrician started to leave again.

"Going to rig up a series test light," Sparks said, "and find where the open is in that line."

The trouble was soon located with the series test lamp and Sparks felt like asking some one to give his pants a kicking. A contactor jumper was broken and hanging down behind the contactor so that the loose end was out of sight.

"I'll be damned!" Evans sighed with relief. "A little thing like that shut down a 100 hp. motor!"

Sparks picked up his tools and from habit felt for his right back overall pocket, then remembered where he had left his overalls.

WALKING rapidly, Sparks went to the electric shop, laid his tools on the bench, then rushed to the roundhouse. The stall was empty where the locomotive that had the overalls on it had been. He rushed outside and looked around. The 5086—that was the engine—was not in sight. Sparks went to the roundhouse office and asked the clerk about the 5086.

"Left town about fifteen minutes ago," the clerk said. "Why? Wouldn't the headlight burn?"

"Headlight was O.K.," Sparks replied, "but I had a nearly new pair of overalls tied on top of the boiler to dry—and overalls are mighty scarce nowadays, besides my wife will give me thunder for getting my pants dirty!"

Sparks' time the rest of the day was, as history says of

Gaul in Caesar's time, divided in three parts—several odd jobs in the roundhouse; cleaning mud from the electric shop; and cussing the division engineer for the track that backed up the water and caused the mud in the electric shop and incidentally cost him one pair of overalls. But Sparks had not learned all of the trouble yet to come because of the track.

The next afternoon Sparks noticed a couple of men from the Engineering department but paid little attention to what they were doing. He found out next day when the master mechanic sent word for Sparks to come to the office.

"Say," the master mechanic began when Sparks entered the office, "How much clearance are power wires supposed to have over a track?"

"Twenty-seven feet," the electrician told him. "All of our lines have plenty of clearance. I checked them not over three weeks ago."

"How about the power lines to the machine shop over the storeroom track?" the master mechanic asked. "I've got a letter here from the superintendent that says they only clear twenty-five feet and nine inches."

Sparks didn't try to keep from swearing, then said, "The wires over the storeroom track had plenty of clearance until the track was raised two feet. It's going to be quite a job to raise them, too," he added.

"Let's go look at them." The master mechanic rose as he spoke and left the office with Sparks following.

"Wires look high enough to me," the master mechanic said. "Can you get a line and measure how high they are?"

"Yes, sir," Sparks said. "But I'm afraid it would be of no use. They just cleared the old track by very little over twenty-seven feet and the track was raised at least two feet. The wires were O.K. long as they left the track alone."

"That's right," the master mechanic agreed, "and I think I know why the division engineer had the height of the wires checked. I've been after him nearly a year to raise the track so cars would come a little above the platform level—makes unloading heavy material easier. Now he's got the track raised and getting back at me. Well, there's nothing left for us to do but raise the wires. How much of a job will it be?"

Sparks squinted one eye and looked at the pole and wires. "Pretty good-sized job! We'll have to trench that pole over and set a forty where that one is. Those six hundred thousand circular mil wires are pretty heavy to handle and the ones leading off to the fill-up and washout plant are four-naught. If we have to splice out the big line to the machine shop, as it looks like now, that means more work."

The master mechanic used a couple of well chosen swear words that expressed Sparks' sentiments exactly, then said, "Have you got a pole that could be used for the job?"

"No, sir," Sparks replied, "and I doubt if there are any secondary racks, guy cable, or any of the rest of the material in the storeroom for the job."

"Well, get it ordered and I'll write the superintendent that we'll raise the line soon as the material arrives." The master mechanic turned and went back to his office. Sparks walked to the electric shop, mentally grappling with the various problems involved in raising the power lines.

BESIDES being a fair-sized job of work, Sparks knew there would be hell to pay if the power was shut off any length of time. Everything received power from the big lines on the pole—machine shop, roundhouse, turntable, water pumping and treating plant, fuel oil station, and every other electrically operated facility in and around the shops depended on that line for current. Every official and supervisor from fuel foreman to division superintendent would be breathing down the electrician's neck wanting to know how soon the power would be on again; Sparks knew from experience. No need to try to find a convenient time to shut off the power. There is no convenient time to shut down the power at a busy railroad roundhouse.

The electrician was so busy the next two or three days that for the time at least he almost forgot about the low wires. Seemed like all of the Army was moving west via the S. P. & W. through Plainville, from the number of troop trains that went through. They ran everything that had wheels under it except the call boy's bicycle, and might have run that if the caller hadn't been on it most of the time. Besides the extra amount of work caused by running so many locomotives, there was some electrical work on the coaches of almost every troop train. Sparks worked so many hours that he forgot when his regular quitting time was.

The strain was telling on Jim Evans, too. Jim has a boy in the Pacific and he feels like that all he can do is little enough. Long hours of work and worry have deepened the lines in Evans' face and furrowed some new ones since the war started, but he says he can rest when it's all over.

After the rush of westbound main trains, things eased off a little at the roundhouse. Sparks went back to working normal time and Evans saw his wife in the daytime a couple of times. Sparks had been planning to clean up the electric shop for the past two months and finally decided he might have time to do it. He had just started pulling things out of the bench when the foreman came into the shop.

"Master mechanic called and said for you to come to the office," Evans told Sparks.

"O.K." Sparks brushed off his overalls with a piece of waste and headed for the master mechanic's office.

"COME in," the master mechanic invited. "Sit down." He indicated a chair, then asked. "How's the job of raising the wires over the storeroom track coming along?"

"Haven't done anything more," Sparks told the master mechanic. "Nothing I can do until we get a pole and the other material."

"Let's go see the storekeeper and see when the pole will be here," the master mechanic said. "Seems like somehow the chief engineer found out about the wires being too low and wrote the superintendent about it," the master mechanic said as they went to the storeroom.

"When you going to get that pole we ordered?" the master mechanic asked the storekeeper.

"Can't say exactly," the storekeeper replied, "but chances are it'll be some time. They won't ship just one pole in a car now and it may be some time before a car loaded with timbers or piling or something they can load the pole with that will be coming this way."

"Well, we've got to have a forty-foot pole," the master mechanic said, "and right away. The superintendent is raising Hades about the wires over the storeroom track being too low."

"Why don't you borrow a pole from the signal department?" the storekeeper asked. "They've got a whole pile of poles of all lengths and sizes down the other side of the B&B lumber yard."

"O.K.," the master mechanic said, "I'll call the signal supervisor. How about using the truck to drag the pole up with?"

"Not today," the storekeeper shook his head, "maybe in the morning," he added.

"Well, that'll be all right," the master mechanic agreed, then turned to Sparks and said, "What's the matter with planning to set the pole and raise the wires tomorrow? I'll see Evans and arrange to have the power shut off a couple of hours right after one o'clock. That'll give you all morning to set the pole and get everything ready."

"A couple of hours won't be long enough to change the lines over and besides, we haven't got the hardware for the new pole," Sparks told him.

"Why can't you use the insulators and things off the old poles?" the master mechanic wanted to know.

"Well, I guess we could, but it'll take quite a bit longer."

"That's up to you to figure out," the master mechanic told Sparks. "I'll see that you get a pole and tell the foreman to give you what help you need setting it. Let's go see Evans now."

"How long will it be necessary to have the power shut off?" Evans wanted to know the first thing when told about the job.

"Well, not less than six to eight hours, I'd say," Sparks told him. "Handling those big heavy wires is slow work and there are lines running in every direction from that pole."

"Good Lord," Evans exclaimed, "practically a whole day lost just raising some wires a couple of feet!"

"Well, it's got to be done and we might as well do it tomorrow as anytime." With that pronouncement the master mechanic turned and went back to his office.

"Hell!" Evans snapped, when the master mechanic was out of hearing, "we can't shut the power off no six or eight hours! We are so far behind with machine work now that it'll take a week to catch up if we don't have another rush. Can't you figure out some way to raise them wires without shutting off the power so long?"

"Don't see how," Sparks said, "but I'll do the best I can."

NEXT morning when Sparks went to the storeroom to go with the truck driver to get the pole he met the master mechanic just coming out of the office.

"Good morning," the master mechanic said. "I'm going to Sanford on No. 2, be back tonight. I'll look the job over tomorrow."

Sparks found plenty of thirty-foot poles, a few thirty-fives, and three forty-foot poles at the signal department pile, but the forties were all too small for the job. Slim and tapering, they looked more like giant fishing poles than what Sparks needed.

"Want to take one of them?" the truck driver asked.

"No," Sparks replied, "none of them would do the job."

"Let's go then." The driver stepped on the engine starter.

"Wait a minute," Sparks said. "Let's get one of them." The electrician pointed to some heavy stub poles about twenty feet long.

"They ain't more than half long enough," the driver argued.

"Well, I've got an idea that might work," Sparks told him.

When they were back at the roundhouse, Sparks found Evans and asked for a couple of laborers to dig a hole.

"I'll let you have the laborers," Evans said, "but we are sure as thunder going to delay some trains if the power is shut off six or eight hours."

"Maybe I can get the wires raised and only shut off the power an hour or so," Sparks said.

"Boy, that'll sure be fine if you can!" Evans grinned.

Sparks showed the laborers where to dig the hole right next to the pole and, "I want it plenty deep," he said. "At least six and a half feet."

The hole was dug and the short pole set in place before noon. When the one o'clock whistle blew, Sparks found the foreman and told him he needed the portable gas-electric crane a couple of hours.

"O.K., but don't shut off the power yet," Evans said. "I've got three engines to get out of the house."

Sparks found the crane operator, then told the two laborers to get a couple of track jacks. While the laborers were gone after the jack, Sparks got a piece of one-inch pipe about ten feet long and screwed a cap on one end.

The two track jacks were placed on opposite sides of the pole and setting on heavy oak boards. Sparks wrapped a chain around the pole and over the jacks to hold them. Then he wrapped another chain higher up and hooked te crane cable to it.

"Now," Sparks said, "let's all work together. Just keep the crane line good and tight and you two men at the jacks raise the pole and the crane will hold it."

Besides having a heavy load the pole was set deep and solid. It was necessary to take a shovel and dig around the pole before it would raise. Finally both jacks lifting and the crane pulling with all its power, the pole raised a little. "Keep it going," Sparks shouted.

"That's all on the jacks," one of the laborers said.

"O.K., hold everything!" Sparks grabbed the one-inch pipe and started tamping around the pole to force dirt under it. "Now let the jacks off and take a new hold," he said. "Keep the crane line light," he added.

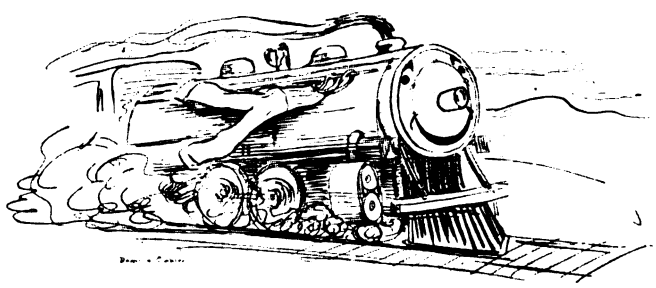
Four sets with the jacks and the pole was raised enough. The jacks were removed and the laborers dug down so dirt could be tamped solidly under the pole. Then Sparks bolted and clamped the pole to the stub. Just as he was finishing, Evans came out and said, "Now you can shut the power off."

"Don't need to," Sparks said. "The job is about done."

Next morning the master mechanic came up to look at the job. Sparks saw him and walked out to where he was.

"What was the trouble, didn't the signal department have a pole long enough without splicing it?" the master mechanic asked.

Sparks' reply sounded like he swallowed his Adam's apple and choked on it.



EDITORIALS

The Future of Material Handling

In order to minimize costs and assure the most favorable competitive position possible when war transportation needs decrease and railroads are again looking for more business, it is important that railroad men start now to review and further improve their methods of handling materials and supplies of all kinds, particularly the vast quantities required in the operation and maintenance of rolling stock.

Take the matter of locomotive coal and water, for example. Railroads pay more for locomotive coal than for any other single item of supplies and the cost of water also is a substantial figure. With the stepped-up tempo of modern railway operation, it is of the utmost importance to place these supplies on locomotives with minimum delay, and coal chutes capable of dumping 43 tons of coal in 75 seconds have been installed, also water columns delivering 5,000 gal. a min. at some terminals. Similarly, facilities for supplying heavy fuel oil to steam locomotives and lighter grades to Diesel locomotives have been installed and need reconsideration with an eye to the future.

Hardly less important than equipment for handling coal and water quickly to steam locomotives is the provision of adequate means for cleaning fires and disposing of ashes with minimum delay. Special equipment for this purpose has been developed and installed at many terminals but many others remain to be equipped. In connection with coal, water and cinder-handling devices, railroads are, as often happens, placed in something of a dilemma. With entirely adequate equipment, for example, at nearby engine terminals, it may be necessary to install additional facilities at selected main-line stations in order to permit running locomotives through and thus secure high utilization of power, as well as avoiding the delay attendant upon changing locomotives. In other words, the primary objective in railroading is to move trains, and special operating requirements frequently necessitate the provision of what would appear in some instances to be almost duplicate fueling facilities.

Similarly, in the servicing of cars, both passenger and freight, large economies can be effected by providing adequate means for supplying all necessary materials quickly and with minimum hand labor. Normally, few supplies are required for passenger cars en route, but a great quantity of materials such as propane gas cylinders, axle generator drives, brake shoes, brake beams, wheels and other mechanical equipment must be available and arranged for rapid handling in order to speed up the turning of passenger cars at terminals. In the case of ice-activated air-cooled cars the problem of ice supplies also presents itself at intermediate terminals. Supplies of many different kinds for freight cars are required at all transportation yards and terminals and it is of the utmost importance, that modern equipment be available for handling and applying these materials with minimum delay and manual labor.

The handling of materials at railway shops and terminals where either light or heavy repairs are made to locomotives and cars constitutes a major problem and, in spite of the great progress effected at some points, many others are still using more or less "strong-arm" methods. Material handling at railway shops naturally divides itself into two general categories, namely, raising or lowering and transverse movement. Thinking about locomotives, for example, the easiest and quickest way to take out the trucks and driving wheels is to provide a shop crane of adequate capacity to raise the locomotive as soon as the main rods, brake beams, binders, etc., have been removed. In some smaller shops, however, where the number of locomotives repaired annually does not justify a large building with relatively expensive overhead traveling crane, electrically operated hoists or drop tables provide the means of removing wheels and this type of equipment is almost exclusively used for that purpose in smaller shops and enginehouses.

Associated with the lifting of locomotives and cars with cranes or electric hoists is their transverse movement for short distances in shops or repair yards for more easy or efficient performance of repair work. This is not commonly thought of as material handling, but it really does constitute moving material in a big way. For example, the adjustment of locomotive position on a shop track while setting valves is done in a great many shops with locomotive spotters, and car pullers, operated by electricity or air, are widely used for pulling cars into shops or at periodic intervals while cars are being given progressive repairs inside. The situation at every major shop, and smaller points as well, should be reviewed to make sure that it is adequately equipped in this particular in the light of probable future needs.

For handling smaller locomotive and car parts and materials, it is safe to say that railway shops and repair points would be completely bogged down under present labor conditions without the power-operated mobile equipment which does so much to increase shop output and reduce manual labor. This equipment utilizes either gasoline, gasoline-electric or straight electric power and consists primarily of crane-equipped trucks, lift trucks, fork trucks, individual delivery trucks, tractors and the

necessary trailers of standard or special-purpose design.

On the basis of information submitted to *Railway Mechanical Engineer,* railroads ordered and for the most part installed in 1944: 195 hoists other than pit jacks which may be compared with 136 in 1943; 486 power jacks were ordered in 1944, compared with 312 in 1943; 351 tractors, trucks and transfers were ordered in 1944, compared with 209 in 1943. The substantial increase in orders for this type of equipment in 1944 compared with 1943 indicates an increasing appreciation of its importance by progressive railway mechanical supervisors who are responsible for shop, enginehouse and repair-truck output. One of the most constructive things they can do, as suggested, in an earlier paragraph, is to review the performance of their present material-handling equipment and make sure, insofar as possible, that it is adequate to meet future requirements.

Lighting Vs. Building Design

A few weeks ago, a group of railroad electrical engineers in discussing lighting of railroad buildings, agreed that no adequate means of lighting enginehouses had yet been evolved. The nearest approach to good lighting probably consists of spread-lens enclosed reflectors or angle reflectors mounted on the columns between stalls. To obtain adequate distribution, the lighting units are usually mounted on stems away from the side of the locomotive to be lighted with the light projected back across the space between stalls. They should be high enough to throw some light on top of the locomotive, but at this elevation they are frequently so far up in the smoke that much of the light is cut off and keeping the fixtures clean becomes so difficult that no one does anything about it. And even when the fixtures are at the desired height, the crane truck frequently knocks them down while applying or removing rods and pumps.

Some promise is offered in the form of fluorescent fixtures consisting of flat reflectors and two 100-watt lamps, the units being hung on chains to permit their swinging when nudged by crane booms. But the best the lighting engineers can do would be materially improved by the cooperation of the building designers.

If adequate lighting in an enginehouse is important, it can be obtained by increasing the height of the building, by improving ventilation and by increasing the space between stalls. An increase in crane truck capacity would also assist the lighting engineers and in many cases reduce time of operations in the enginehouse. The increased height of the building and the better ventilation would of course raise the smoke level. This would permit of better light distribution and assure a reasonably long period between fixture cleaning times. The wider space between stalls would also allow for better light distribution and would improve working conditions. Many of the crane trucks now in service are scarcely adequate for the increased duties they are expected to perform. The limited capacity and the limited space frequently requires considerable jockeying to get the crane in a position where it can lift with an almost vertical boom. This takes time and frequently also knocks down the lighting fixtures.

Since lighting engineers have tried so long with only moderate success to light an enginehouse, perhaps it is time for the building designers to give them a break.

Are Riders Needed On Diesel Locomotives?

As the number of months and years go by in which Diesel-electric road locomotives pile up service mileage it is interesting to observe the attitude that operating and mechanical officers and supervisors have toward certain phases of the operation of this type of power. Until actual records of performance had discounted many of the theories held by individuals in the early stages of its use the Diesel-electric was the object of unfavorable comparisons in the matter of cost. Fortunately for the proponents of Diesel power there are available more comprehensive and accurate operating-cost data with respect to its use than is the case with steam power.

It is of value, therefore, to have an opportunity to examine the operating costs of a group of both freight and passenger Diesels that have been in continuous service since the last half of 1941. It is not intended here to go into detail except to present sufficient data to form a background for a discussion concerning "riders", or, as they appear in the statistics, "attendants". The question under discussion on many roads is, "Shall we take the riders off, or leave them on?"

Possibly a study of the operating cost records may help throw some light on the subject. Here are some costs on one road:

Year ended June 30	Maintenance cost per unit-mile		Operating cost per unit-mile	
	Freight	Passenger	Freight	Passenger
1942	$0.080	$0.117	$0.136	$0.091
1943	0.111	0.122	0.173	0.104
1944	0.119	0.135	0.183	0.112
1945*	0.115	0.151	0.184	0.116

* 10 months only.

Note: The unit in freight service is a two body unit, 2,700 hp.; in passenger service a single body unit, 2,000 hp.

In the figures in the accompanying table the maintenance cost includes the cost of attendants and the operating cost is exclusive of the wages of engine crew. At the end of April, 1945, the passenger locomotives had operated over 30 million unit miles and the freight locomotives over 7 million unit miles.

Equally interesting are the percentage ratios of labor, material and attendants in the maintenance cost figures shown above. These appear in the second table.

	Labor		Material		Attendants	
	Freight	Passenger	Freight	Passenger	Freight	Passenger
July 1942	45.2	39.4	12.7	46.1	42.1	14.5
July 1943	28.5	39.2	24.5	45.5	47.0	15.3
Jan. 1944	30.9	40.2	30.5	45.3	38.6	14.5
July 1944	33.2	40.3	30.9	45.4	35.9	14.3
Jan. 1945	34.3	38.5	37.3	48.8	28.4	12.7

These percentage relationships to total maintenance cost indicate the changing conditions under which this power is operataed. As the equipment passes out of the initial period of use and both operating and mechanical departments become more familiar with it there are many evidences that, being a piece of machinery operating in rail transport service, the maintenance cost relationships will, in the long run, not differ so widely from steam or electric locomotives.

Many railroad officers are discussing the possibilities of removing riders from road Diesel locomotives. To those who view this action from the standpoint of expense alone it may be worth while to suggest a very careful study of the maintenance cost records of those roads that have done so. It may be discovered that it will be worth while to look upon the rider, or attendant, in exactly the proper light, namely that of a combined inspector and repair man who is one of the best examples of preventive maintenance that we can think of at the moment.

One chief mechanical officer, faced with pressure from management to reduce expense in this manner expressed himself as being entirely willing to charge the entire expense of riders to the locomotive repair account in full confidence that by so doing the combined labor and rider cost would be no greater than the increased labor costs where no riders are used.

A Critical Time For the Car Department

A study of the accompanying table should make it easy to pick out the railroads upon which the car-department officers are being strongly urged to repair and return bad-order cars to service. The figures shown represent the reported bad-order position of each road on May 15 of each of the last three years; the national figures have been: 1943, 2.8 per cent; 1944, 3.0 per cent; 1945, 3.6 per cent. It happens that the 1945 national average is the same as it was for the same date in 1942.

Anyone who believes that the May, 1945, percentage of bad-order cars can be forced down later in the year to the low level of 2.5 per cent for November and December, as was the case in 1942, is unaware of the real condition of the car inventory today. This year we are dealing almost entirely with the same cars that were in the inventory in 1942, cars which in the meantime have accumulated previously unknown highs in both car-miles and ton-miles, cars which have received a minimum of repair attention, tens of thousands of them now being long overdue for class repairs, and that face the prospect of a continued intensive use which may even exceed that to which they have previously been subjected in length and speed of runs, and distances between regular inspection points.

It is important that these facts be recognized. Car departments can do only so much and despite their best efforts the bad-order car situation will grow increasingly worse during 1945, not better as it did in 1942. The figures shown include only five days of operation under the new A.A.R. emergency order permitting the short routing home of cars which cannot be made fit for rough loading by the expenditure of approximately $130 or $105, respectively, in the case of all-steel house cars and all-steel open-top cars. Already the effect of the order is beginning to show in a marked increase in the percentage of bad-orders on some roads.

May 15 Bad-Order Condition Reports of Roads Owning 10,000 or More Freight Cars*

	1943	1944	1945
Delaware & Hudson	3.4	2.9	2.7
Delaware, Lackawanna & Western	2.7	3.2	4.8
Erie	2.7	4.1	3.5†
Grand Trunk Western	4.1	5.6	4.2
Lehigh Valley	2.2	2.4	3.1
New York Central	3.1	3.5	4.2
New York, Chicago & St. Louis	2.2	3.0	2.8
New York, New Haven & Hartford	3.1	2.3	4.1
Pere Marquette	3.3	2.8	2.6
Pittsburgh & Lake Erie	2.6	3.1	4.2
Wabash	1.7	2.9	3.6
Wheeling & Lake Erie	3.0	2.4	4.0
Baltimore & Ohio	2.9	3.1	4.9
Bessemer & Lake Erie	3.3	4.0	3.8
Central Railroad of New Jersey	1.3	3.0	5.5
Pennsylvania	3.2	3.8	4.5
Reading	2.3	2.2	2.8
Western Maryland	0.9	1.1	0.8
Chesapeake & Ohio	1.2	1.4	1.4
Norfolk & Western	1.8	2.7	2.0
Virginian	1.9	2.3	3.4
Atlantic Coast Line	2.7	3.1	1.8
Illinois Central	1.1	1.2	1.4
Louisville & Nashville	2.0	3.6	5.1
Seaboard Air Line	2.0	2.3	2.3
Southern	1.6	1.6	2.9
Chicago & North Western	5.2	4.1	3.7
Chicago, Milwaukee, St. Paul & Pacific	1.5	1.9	2.2
Great Northern	2.4	1.8	3.6
Northern Pacific	3.5	3.5	4.1
Atchison, Topeka & Santa Fe	3.6	3.0	4.0
Chicago, Burlington & Quincy	2.8	3.2	2.3
Denver & Rio Grande Western	3.0	3.4	5.6
Southern Pacific	2.8	3.1	3.6
Union Pacific	2.9	3.0	5.1
Missouri Pacific	1.8	2.0	2.3
St. Louis-San Francisco	3.6	2.5	2.1
Texas & New Orleans	3.0	4.2	3.5

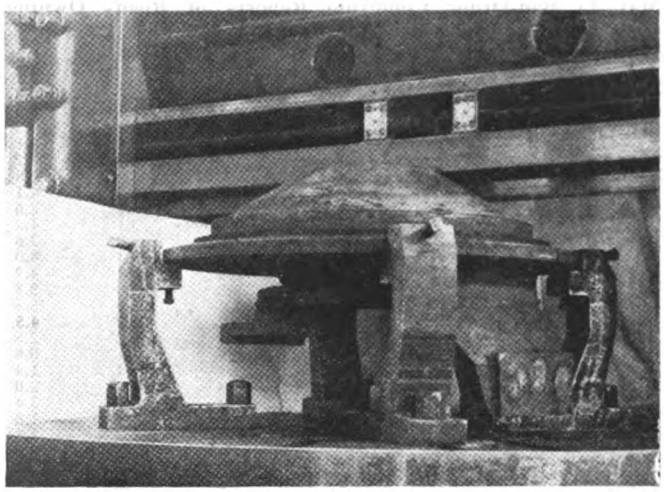
* Does not fully reflect the effect of the emergency short-route-home order of the A.A.R. which went into effect May 10, 1945.
† Previous report.

Undoubtedly, a determined effort will be made to repair cars currently but as the deferred maintenance on equipment has accumulated each individual repair job involves the expenditure of more man-hours and the use of greater quantities of material. Before the end of the year the full railroad transportation job in this country in furthering the war effort against Japan will be accomplished only as the car-repair shops and the rip tracks of the railroads can keep enough freight cars in service. No one should minimize the possibility of serious transportation tie-ups resulting from car shortages. Obsolescence, normal and accelerated depreciation, and deferred maintenance are all working to make the job of the car department harder as the need for cars shows no signs of declining. It will take good organization, more men, an adequate and free-flowing supply of material, and full support from top management to enable the car departments to meet this test.

Holding Locomotive Parts For Machining Operations

*By J. R. Phelps**

The illustrations show a number of devices which are useful in holding locomotive parts for necessary machining operations. They will prove time savers in any shop



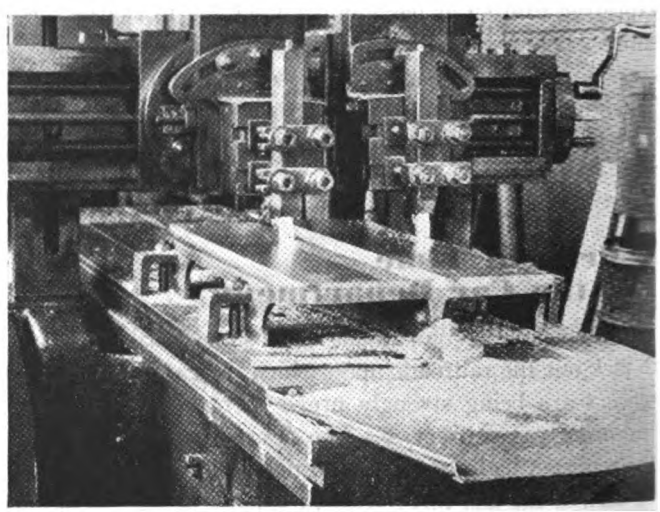
Cylinder back head mounted on boring-mill table by the use of specially designed clamps which provide clearance for the guide blocks on the head

and are especially important where the monthly shop output is high and savings in machine set-up time can mean the release of additional units.

The second photograph shows a clamp which is used for holding locomotive tires on the boring mill table for boring the inside or turning the outside of the tires. The foot of the clamp slides in the slot on the boring mill table and the upper part of the clamp extends over the tire. All bolts, blocks and other clamps are eliminated and every bit of pressure applied through the set screws in the clamps is a downward holding pressure. The blocks on the table on which the tire is set are tongued on the bottom to fit the table slots and are checkered on the top to keep the tires from sliding. The use of these clamps and blocks permits setting the inside flat face of the tire at an even distance above the table surface and assures accurate machining and means that no variation in spacing will be encountered when applying the retaining rings when tires are mounted on the wheel centers.

The clamps shown are for machining a back cylinder head on a boring mill. Where the guide blocks are cast solid on the back heads an extra high chuck jaw is required to hold them. This is also true with some designs of front heads. The jaws shown in the photograph can be made in the blacksmith shop and will prove more satisfactory for machining the inside of back cylinder heads than is the practice of blocking these parts up on the table under the regular chuck jaws. Suitable adjustments for leveling are obtained from the set screws in the bottom of the clamp and the angularly set top screws give both lateral adjustment and serve to hold the work piece firmly in position.

The illustration below shows a fixture which is used on a planer bed for planing crosshead liners. The liners, after having been drilled and tapped, are mounted

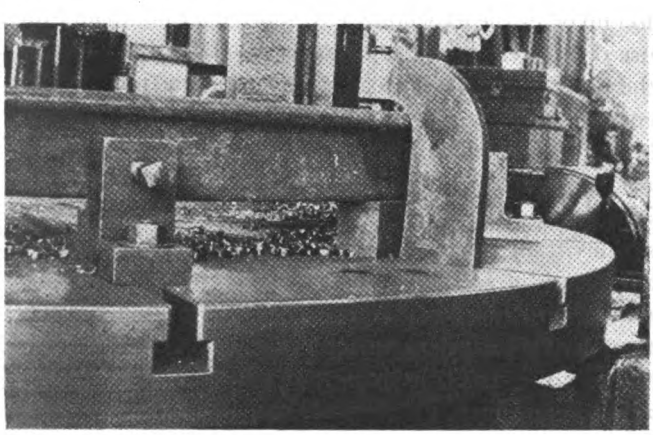


Crosshead guides, after being drilled and tapped, are held on this planer fixture with cap screws

on this fixture. The standard tapping for the liners is a ½-in. standard thread and ½-in. cap screws are used with the fixture. They are applied from the under side and threaded into the drilled liners and are then tightened with a ratchet-type socket wrench. This fixture is made from a 10-in. channel, two sections of which are welded together side by side. A toe is welded on to the side section of the channels to give a total height to the fixture of 4⅜ in. from the table bed.

A holding fixture, not illustrated, is used in the drilling and tapping of crosshead liners before they are machined on the planer. This is so built that nine liners can be squared against the back and one end of the fixture and held firmly in position by set screws. A drilling tem-

* Machine shop foreman, Atchison, Topeka & Sante Fe, San Bernardino, Calif.



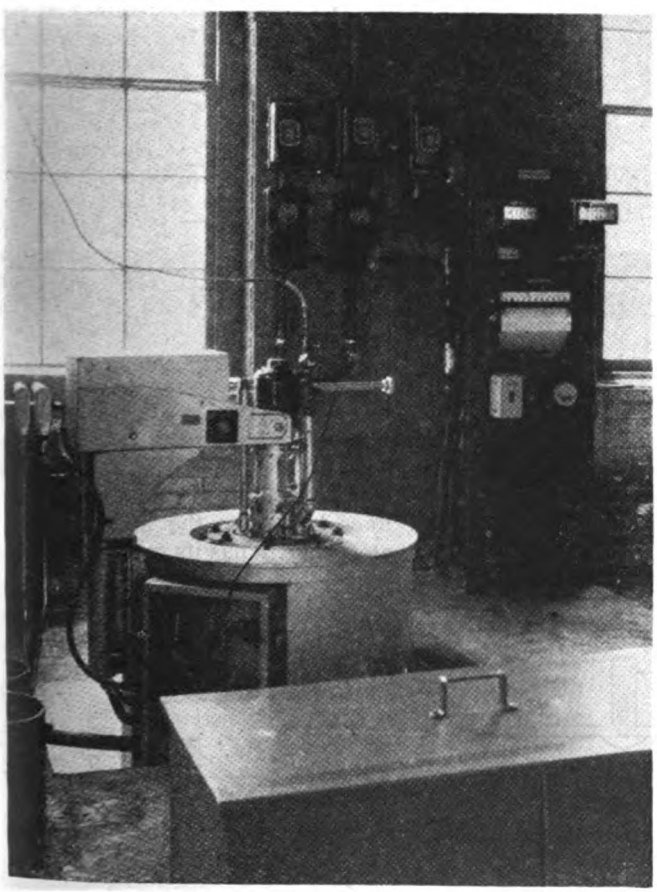
Holding clamps designed to position locomotive tires properly on the table of a boring mill

plate is clamped in the bundle as the top sheet. It serves as the drill guide and makes the drilling and tapping of these parts on a standard drill press a very simple matter. The use of this fixture together with the one described for the planing of these parts results in a very considerable saving of time.

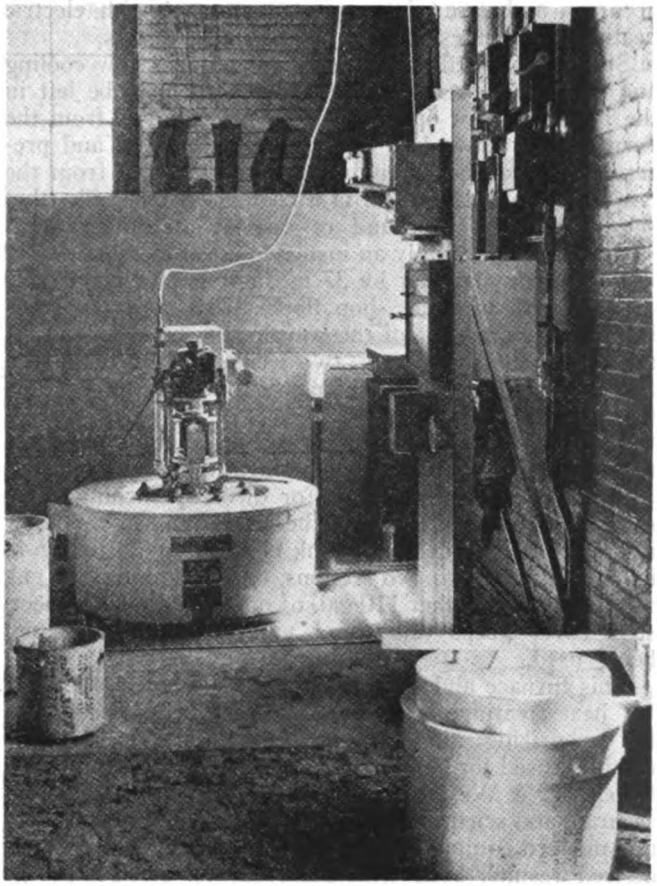
Carburizing Furnace at G. B. & W. Blacksmith Shop

An important item of new equipment, recently installed in the Green Bay & Western blacksmith shop, Green Bay, Wis., is the Hevi-Duty electric furnace, shown in two of the illustrations and used for annealing, hardening and carburizing locomotive spring pins and bushings, valve-gear links and blocks, valve-motion pins and bushing, etc. The unit has not been in service long enough to demonstrate possible economies, but it is anticipated that the service life of locomotive parts effectively heat treated and surface hardened will be more than doubled.

The electric carburizing furnace, illustrated, is an HD-1020 type, located for convenience of operation in a concrete-lined pit in the blacksmith shop floor and fully equipped, with electric controls, indicating and recording pyrometers, etc., mounted on the switchboard panels on the adjoining wall. The furnace proper comprises a heavily-insulated sheet-metal cylinder, roughly 40 in. in diameter by 40 in. high, set vertically in the pit and constructed with zone electric heating elements built into the side walls around the loading space.



Hevi-Duty electric carburizer installation at the G. B. & W. blacksmith shop with control panels in the background and quenching tank in the foreground



The cooling chamber shown in the foreground—Baskets for holding parts in the furnace are shown at the left

An electrically operated cover, which rests on and seals the furnace, is also thoroughly insulated and contains a built-in electric fan which circulates carburizing gas, generated from Carbonol fluid, delivered to the furnace through a small copper-pipe connection to a wall-mounted tank.

Inserted in the furnace and supported from a flange at the top is a closed retort, made of a cast alloy and designed so that the top of the rim has a groove and asbestos gasket to make an air-tight joint when the top cover plate is lowered into position and secured with the eight holding bolts and nuts. The work-holding baskets or pots, also made of a nickel-chromium alloy, are designed with removable perforated bottoms so as to permit and, in fact, direct the flow of carburizing gas upward through the charge. The total work-loading space is 9¼ in. in diameter by 19½ in. high and this may be utilized in a single basket or stacked baskets of smaller size. The lower basket rests on a grate-like support which does not impede the flow of gases through the perforated bottom.

In operation, therefore, the charge of work in this electric furnace is brought to the desired temperature and carburizing gas circulated downward through the space purposely left between the walls of the retort and the basket and upward through the center of the basket and its contents. At the top of the basket part of the gas leaves the retort through an outlet pipe in the cover, but the remainder is re-energized with inflowing fresh gas and recirculated.

This forced circulation of carburizing gas, cracked into its active components, is continued as long as required dependent upon the type of steel used in the locomotive parts and the depth of case hardening desired. The

accuracy and ease of temperature control with electric heating contributes to uniformly reliable results.

Since carburized parts sometimes require slow cooling and reheating for hardening, these parts may be left in the retort without opening the cover, removed from the furnace and allowed to cool outside. Another and preferable method is to remove the parts quickly from the hot retort and place them in a cooling chamber like that shown in the foreground of one of the illustrations. This chamber is simply an insulated covered container 19 in. in outside diameter by 37 in. high set for about half of its length into the shop floor. The cover is easily lifted and swung out of the way by the hand lever. At the left of the same view, two baskets of different size are shown ready for loading with parts to be carburized.

The other view shows the furnace installation with electric controls and pyrometer equipment mounted on panels between the two windows. For direct quenching when necessary, the tank shown in the foreground of this view is used. This welded steel tank is 24 in. by 24 in. by 48 in. and divided into two sections, one containing 110 gal. of water and the other 110 gal. of quenching oil. A sheet-steel cover keeps this water and oil clean when not being used.

This furnace and equipment, while designed primarily for heat treating steel parts in controlled atmospheres for carburizing, nitriding or dry cyaniding, is also successfully used for general hardening and annealing work. Green Bay & Western experience indicates that the more accurate and scientific heat treatment, made possible with this modern equipment, is really essential in order to get desired results, both with plain carbon steels and the alloy steels now being much more widely used in locomotive construction.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Laying Out Staybolts in Door Sheets

Q.—Is it satisfactory, when laying out the staybolts for a firebox door sheet, to take the maximum pitch of the staybolts as computed for the flat plate and locate the first row of staybolts from the corner flange, by taking this distance as the pitch from the point of tangency of the corner radius to the first row of staybolts?—E. A. D.

A.—It would be satisfactory to take the pitch of the first row of staybolts from the point of tangency of the corner radius providing the firebox door sheet and the wrapper sheet are at 90 deg. to each other. According to the A. S. M. E. formula, the pitch from the staybolts next to the corner to the point of tangency of the corner curve shall be:

$$p = \frac{90\sqrt{C\frac{T^2}{P}}}{\alpha \text{ (angularity of tangent lines)}}$$

where p = maximum pitch measured between straight lines passing through the centers of the staybolts in the different rows, which lines may be horizontal, vertical, or inclined, in.

P = maximum allowable working pressure, lb. per sq. in.

T = thickness of plate in sixteenth of an in.

C = 112 for stays screwed through plates not over 7/16 in. in thickness with ends riveted over.

C = 120 for stays screwed through plates over 7/16 in. in thickness with ends riveted over.

α = angularity of tangent lines (Fig. 1).

An analysis of the formulae might clear up this question.

$$p = \frac{90\sqrt{C\frac{T^2}{P}}}{90}$$

$$p = \frac{90\sqrt{C\frac{T^2}{P}}}{\sqrt{C\frac{T^2}{P}}}$$

$$p = \frac{\sqrt{C\frac{T^2}{P}}}{135}$$

$$p = \frac{2\sqrt{C\frac{T^2}{P}}}{3}$$

$$p = \frac{90\sqrt{C\frac{T^2}{P}}}{180}$$

$$p = \frac{\sqrt{C\frac{T^2}{P}}}{2}$$

Fig. 2, 3 and 4 show clearly the effect that the angularity of the tangent lines has upon the formulae. In Fig. 2, showing a 90-deg. corner, p has its greatest or full value. In Fig. 3, showing a 135 deg., the value of p is

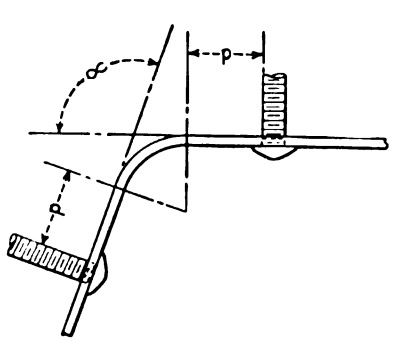


Fig. 1

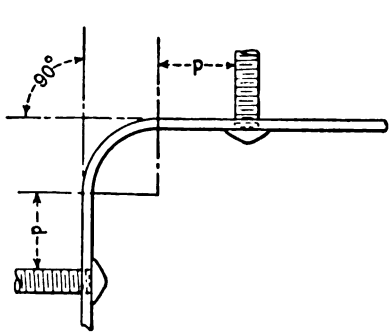


Fig. 2

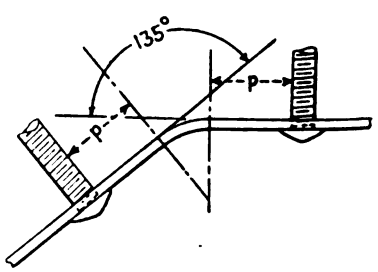


Fig. 3

reduced as the sheets tend to flatten out, the value received from the strength of the corner becoming less. Fig. 4, showing a 180-deg. corner, which is a flat plate, the value of p is the least, the pitch of the staybolt receiving no

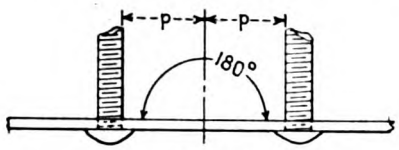


Fig. 4

support from the corner. From these three figures it can readily be seen that the angularity of the tangent lines is the determining factor as to how the value of the strength of the corner influences the pitch of the staybolts.

Welding Flash Plates In Locomotive Tenders

Q.—The swash plates in some tender tanks were welded to the tender bed with ¼-in. fillet welds, the swash plates being ¼ in. thick. Would the job have been stronger if these swash plates had been secured to the bed with a vee-weld?—R. A.

A.—In calculating the strength of fillet welds, made by the shielded-arc process, the stress is computed through the throat of the fillet. The throat of an ordinary 45-deg. fillet weld is taken as 0.707 of the size of the fillet weld. This for a ¼-in. fillet weld would be .25 x 0.7 or 0.175 in. In computing the strength of a vee-weld, the weld is taken as the same as the cross-section of the plate, in the case of a ¼-in. plate this would be 0.25 in.

It will be seen from the following table that the vee-weld is the stronger but the fact that the swash plates rest on the top of the tender bed makes the fillet weld the more desirable to use in securing the plate to the bed.

Value of welds in shear per linear in.
Fillet weld, lb. ..... 0.175 x 13,600 = 2,380
Vee-weld, lb. ..... 0.25 x 13,600 = 3,400
Value of weld in tension per linear in.
Fillet weld, lb. ..... 0.175 x 16,000 = 2,800
Vee-weld, lb. ..... 0.25 x 16,000 = 4,000

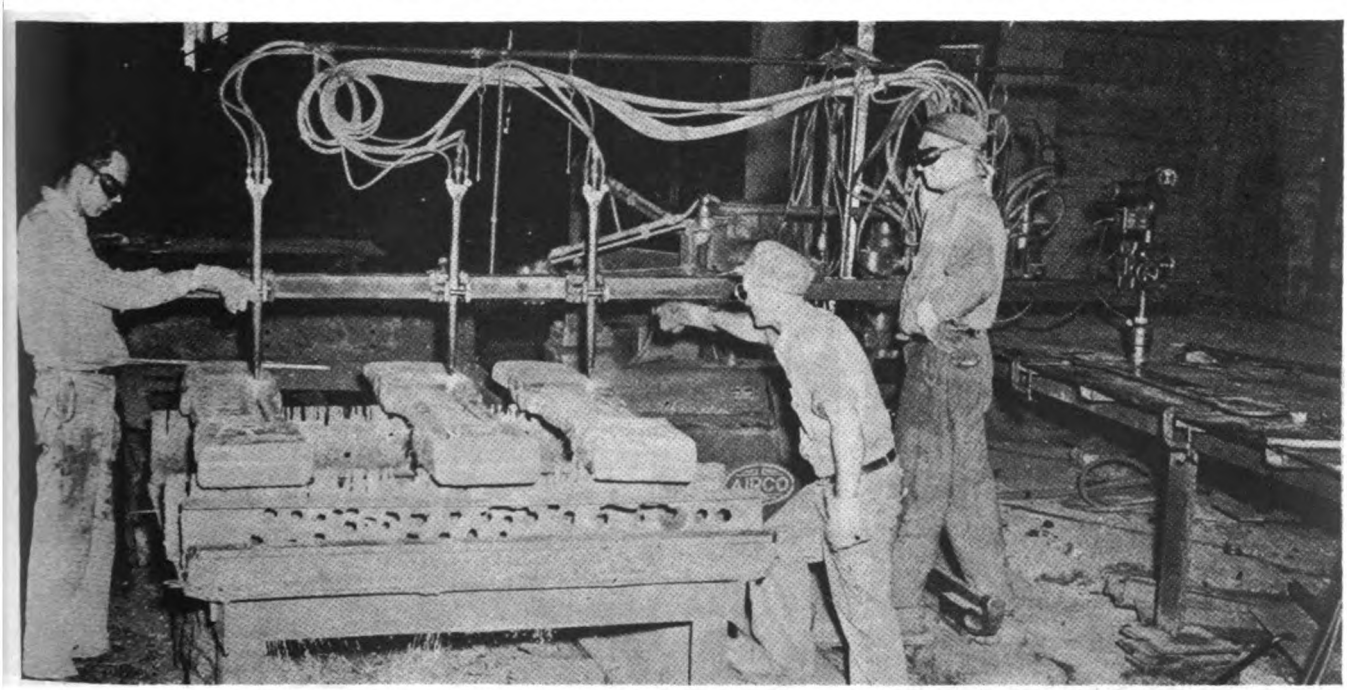
Where the question of strength is involved, it would seem preferable to use a fillet weld on both sides of the plate. The general practice in securing swash plates to tender beds is to use a ¼-in. chain fillet weld 3 in. long on an 8-in. pitch.

Multiple Torch Cutting of Side Rods for Locomotives

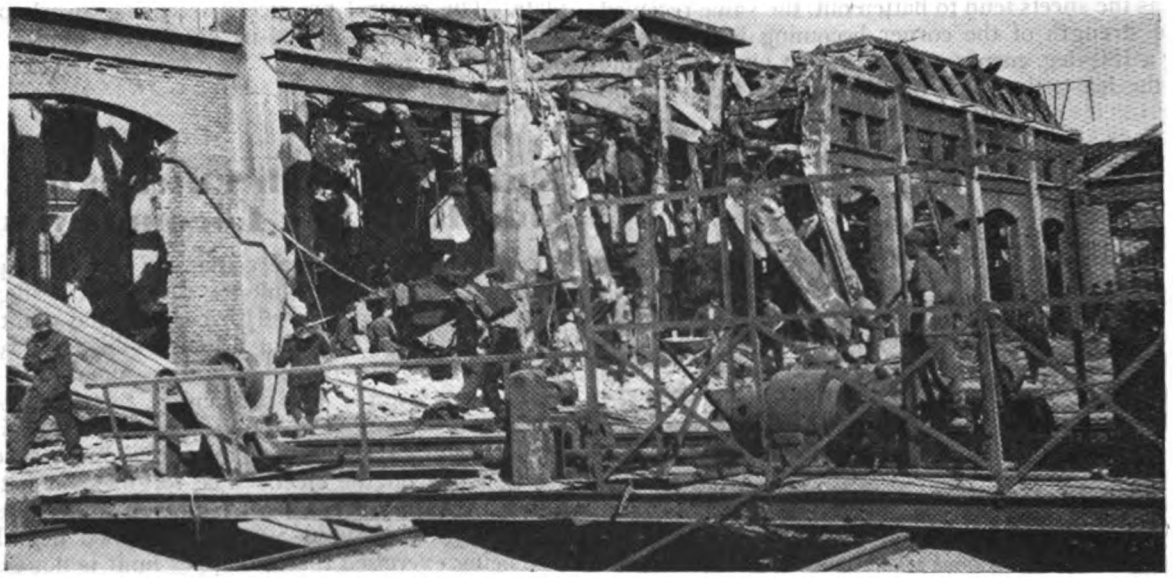
Locomotive side rods are commonly cut to shape from rolled or forged steel blanks by the use of a single oxy-acetylene cutting torch. However, at the plant of the Barium Steel Company in Canton, Ohio, a three-torch machine has been used for cutting thousands of side rods. Steel for the side rods cut at this plant is of the 1045 analysis, forged to rough shape. The forgings are checked with a scribing template and two reference marks are punched on the steel. The forgings, in batches of three, are then placed in a heating pit and preheated to a temperature between 500 deg. and 600 deg. F. with care being exercised that the upper limit is not exceeded. The next step calls for placing and aligning the pieces on the cutting table where they are descaled with a round multi-flame descaling tip which is passed over the line of cut to remove forging scale. This scale must be removed to prevent its interference with cutting.

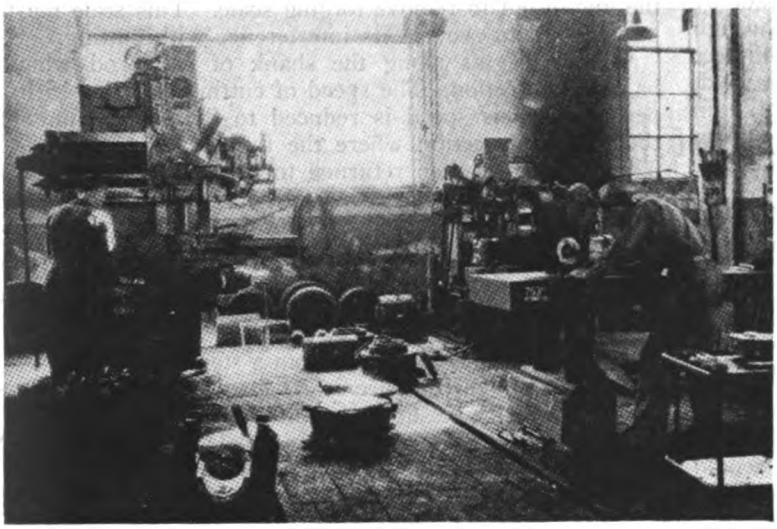
Cutting begins along the shank of each rod which has a 2-in. section. The speed of cutting is up to 15 in. per min. This speed is reduced to 8 in. per min. on the 4-in. end section where the first cut is terminated. The torches are then returned to the starting point and cutting is resumed in the opposite direction with a speed of travel of 6 in. per min. on the 5-in. end section. The cut then continues along the shank until severance is completed. Adjustments in torch elevation are made manually by the machine operators. The Airco Travograph which is employed is equipped with a magnetic tracing device and is guided from a steel template.

Oxygen gauge pressure is 50 lb. per sq. in., a comparatively high pressure being needed to assure penetration of the cut through adherent scale on the forgings. Heavy pre-heat cutting tips are used. Cuts are made to within ¼ in. of the finished size of the rods.



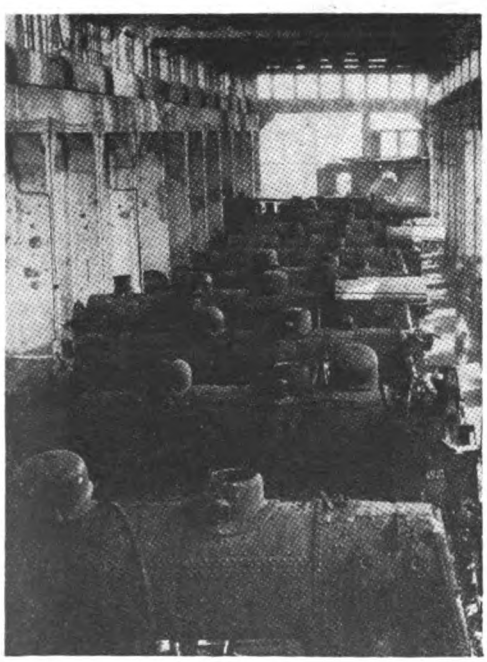
Three side rod blanks being flame cut to rough size in a single operation

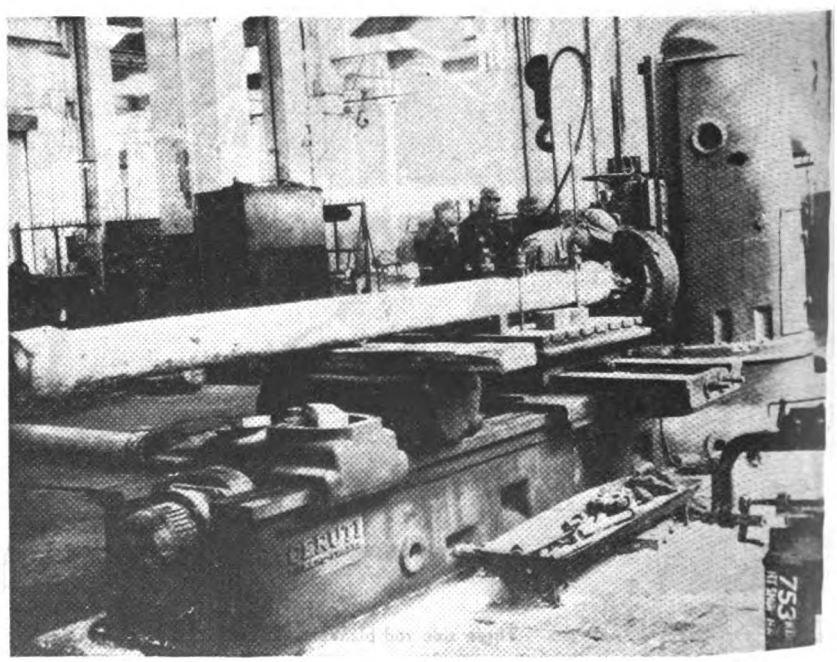




753rd Railway Battalion Rebuilds Italian Railroad System

THE officers and men of the Army Transportation Corps had only ruins to work with when they began the job of rebuilding the Italian railways. The photograph at the top of the page shows what was left of an enginehouse after German bombs got through with it. At the left Staff Sergeant Stephen Heinrich of Chicago is busy laying out a new crosshead to replace one that the retreating Germans had destroyed. T/3 George Steubben of Marshall, Texas, is shown, below, facing the joint of a dry pipe on a horizontal mill salvaged from a bombed-out Italian arsenal and rebuilt by the 753rd.





With the Car Foremen and Inspectors

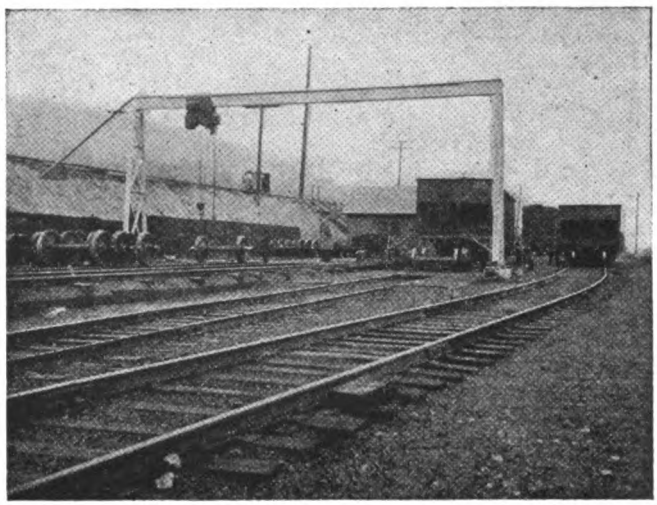
New Wheel Track on The Lehigh & New England

The Lehigh & New England has relocated its wheel track at Pen Argyl, Pa., and installed the facilities which are shown in the illustrations. The relocation has resulted in time saving on car movements which averages better than a day per car and eliminates a number of extra shifting movements on each car requiring the changing of wheels. The new facilities still further reduce the repair-track time and the labor required per wheel change.

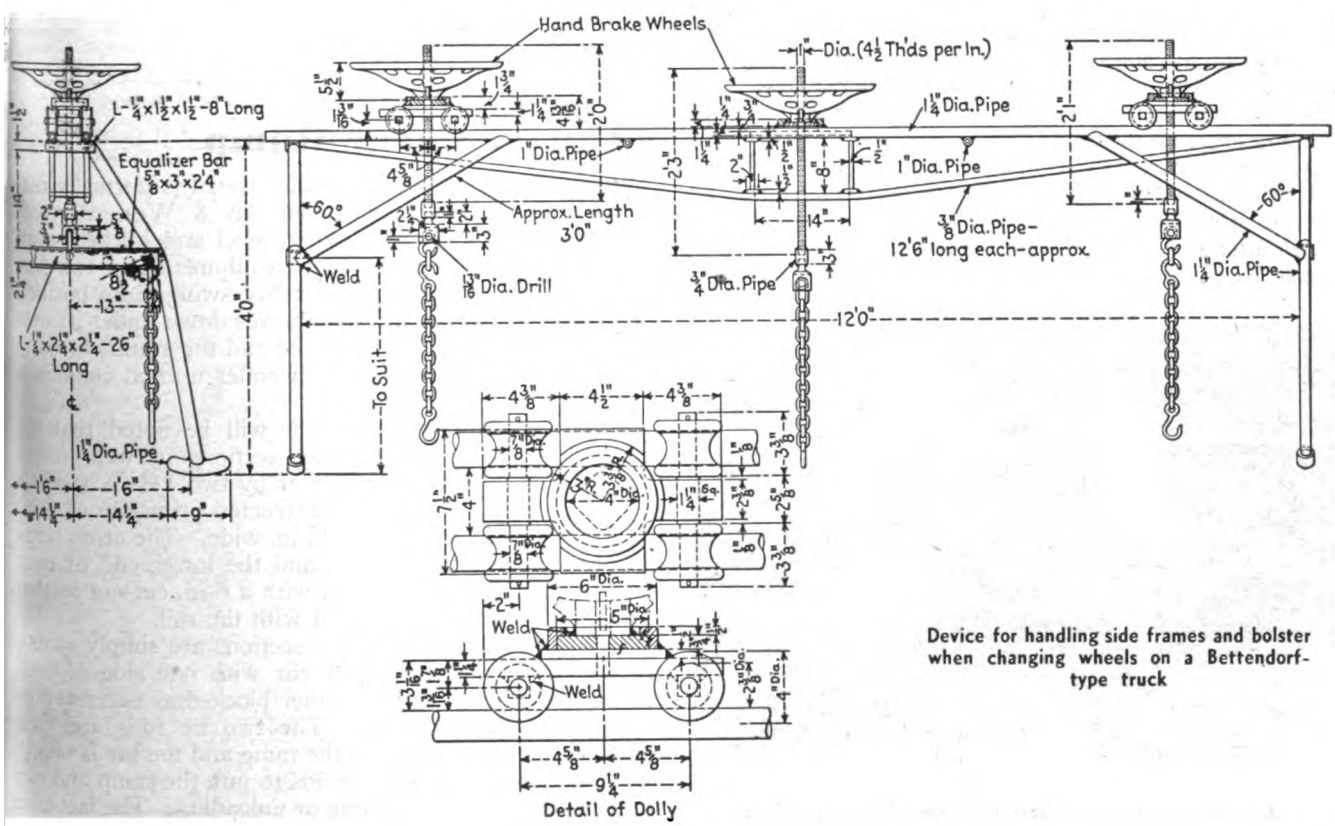
As now located the wheel track is adjacent to the principal receiving yard and cars needing new wheels are drilled out of trains and left on the wheel-track lead. The track to the wheel-change location is graded so that cars are easily moved down it to the working area. When a wheel change has been made cars continue through onto a holding track from which they are removed by yard switchers for placement in trains.

The layout of the working location is unusual. Crane service for handling wheels being removed or applied and for unloading or loading wheel cars is provided by a five-ton capacity Chisholm-Moore electric hoist which has a pendant control station and is mounted on a monorail craneway which extends across the wheel-change and wheel-storage tracks.

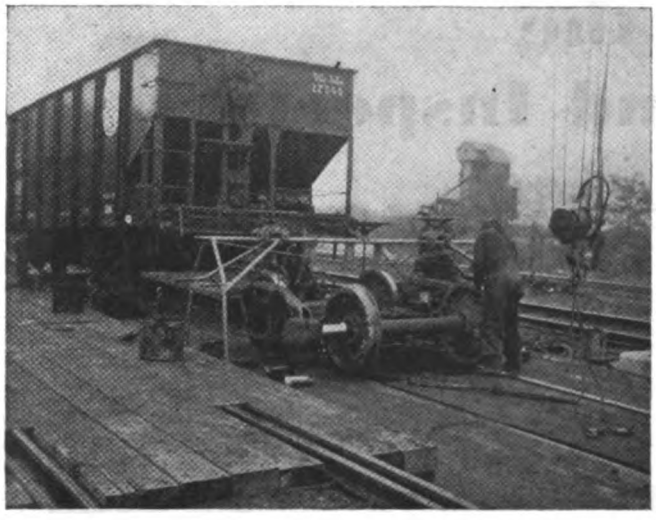
There are two new-wheel storage tracks having a length of 117 ft. and two old-wheel tracks which are 50 ft. in length. The wheel-change point has platform planking for a distance of 48 ft. on each side of the track at the changing spot and there is a 10-ft. planked area between the rails at the center of this outside planked working space. A storage platform for side frames, bolsters, springs, brake beams and other truck parts adjoins the immediate working area. A small tool shed and oil house with a record desk is located at the end of the platform.



The new wheel track of the Lehigh & New England at Pen Argyl, Pa.



Device for handling side frames and bolster when changing wheels on a Bettendorf-type truck



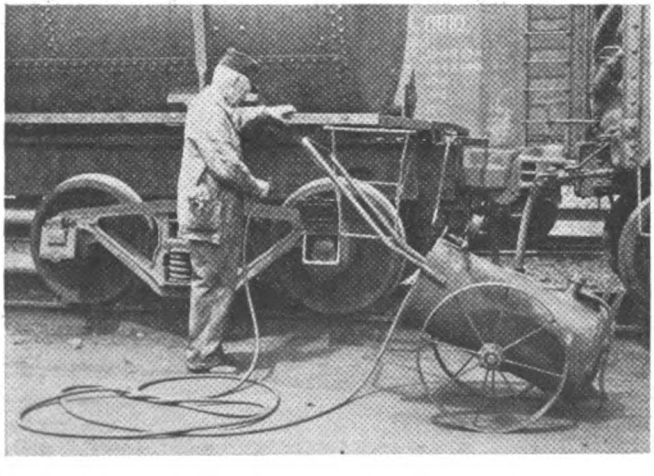
Planked areas provide a good working location for the car repairers

Two Duff-Norton 50-ton air-operated jacks have been installed for raising cars from which trucks are to be removed. Trucks, after removal, are worked under a portable A-frame type device built at the Pen Argyl shops. The frame is similar to the one in use on the Chicago, Burlington & Quincy which was described in the June, 1944, issue of the *Railway Mechanical Engineer,* page 278. The drawing appearing with this article was prepared by an L. & N. E. draftsman working from the illustration appearing on page 279 of the issue mentioned.

Service Carts for The Car-Repair Track

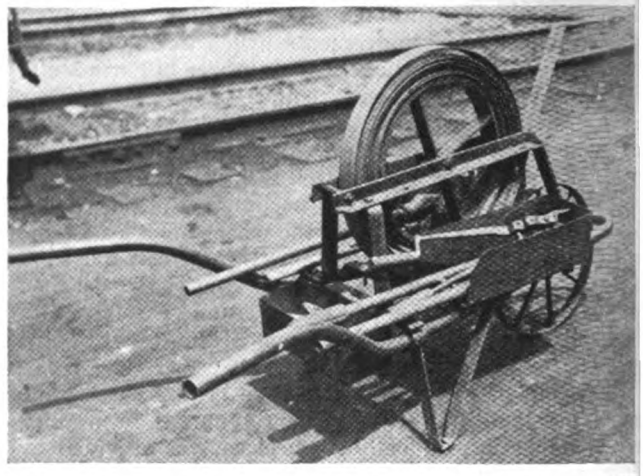
Two devices for car-repair yards which have resulted from the Erie's encouragement of job analysis on the part of employees are now in general system use after being tried out at Marion, Ohio, where they were first developed. One is an oil cart for the use of the car oilers, the other a service cart for carmen and inspectors engaged in banding loads on open-top cars.

The car-oil cart consists of a portion of an old air reservoir which has been fitted with required filling ports, an air-pressure gauge, a relief valve and a discharge port to which a length of ½-in. hose is connected. A pistol-grip nozzle is used to direct oil into journal boxes. The oil capacity of the cart is 10 gal. and when this amount of oil has been put in the reservoir the filling port is closed. A connection is then made to the shop air line and the reservoir is charged with air up to about 50 lb. pressure. When so charged with oil and air under pressure the cart can be used by the car oiler to service between 50 and 60 cars. The ease of its use has resulted in a generally more satisfactory condition in the journal boxes of cars leaving yards where it is used. Car oilers need no longer make repeated trips for fresh supplies nor carry heavy cans of car oil for considerable distances.



A car-oil cart which replaces hand-can oiling on the Erie

The banding cart is made in wheelbarrow style and carries all necessary tools and supplies for a gang doing this work. The one shown has on it a roll of 2-in. high-tensile steel banding, a banding machine, band stretcher, cutters, banding seals and stake packet protectors. The reel for the roll of banding makes the handling of this material much easier and safer for workmen.



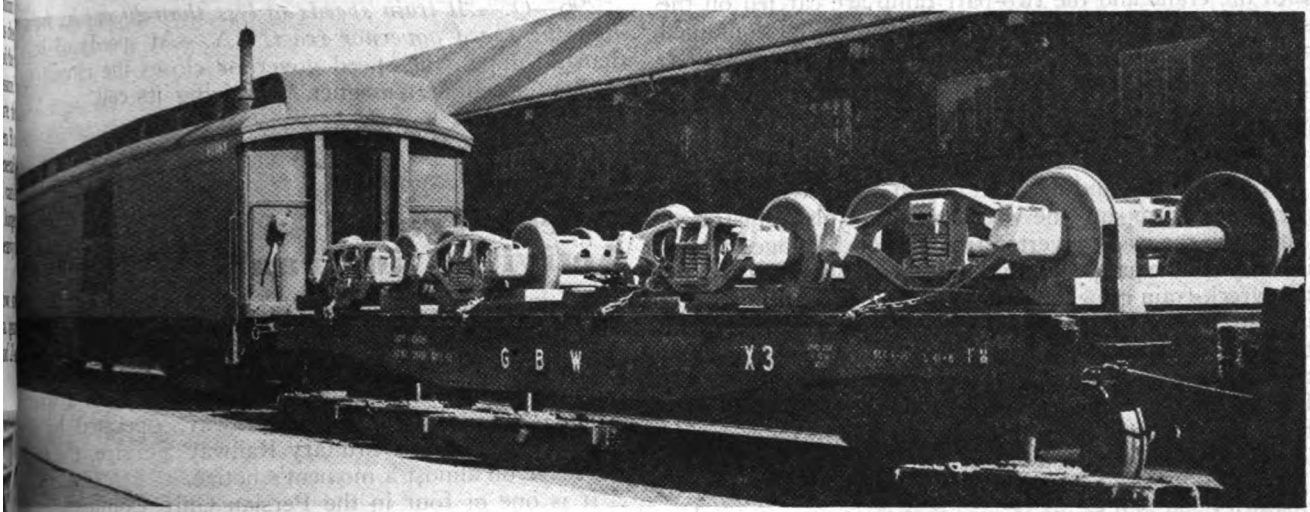
Service cart for load-banding gang

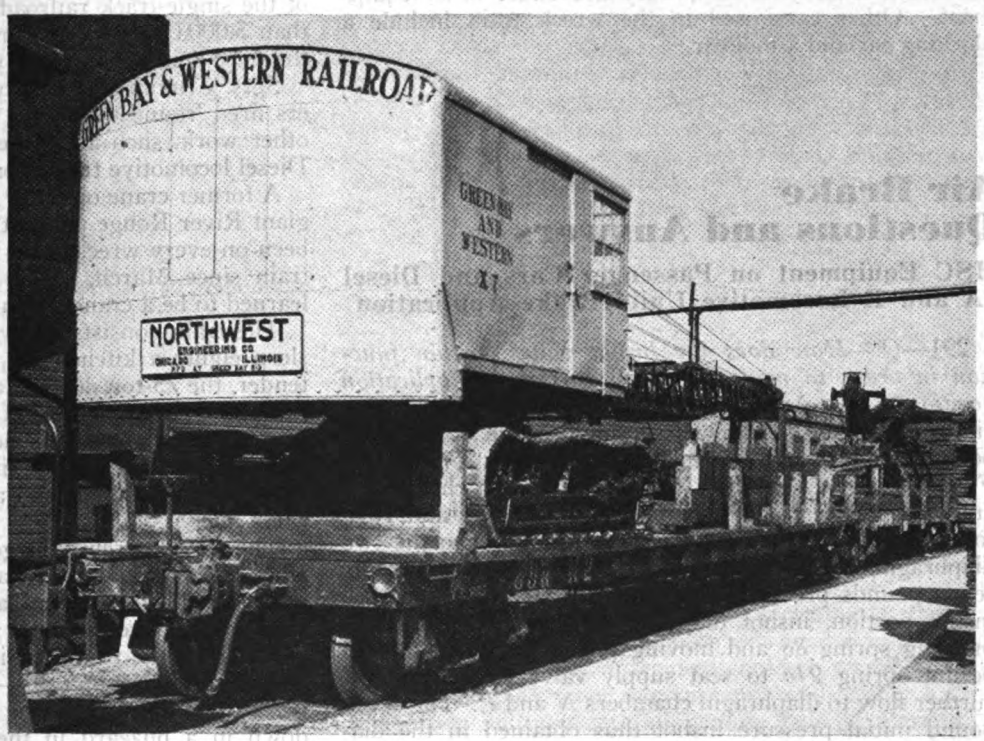
G. B. & W. Crawler Crane Ramp

The Northwest crawler crane illustrated is normally carried on a flat car in the Green Bay & Western wreck train with an easily attachable shovel and bucket on an adjoining car. A feature of the equipment is a two-part ramp which the crane itself readily swings into position at the end of the car and then moves down under its own power. This ramp can be placed and the crane moved to the ground ready for operation under normal conditions in 15 min. or less.

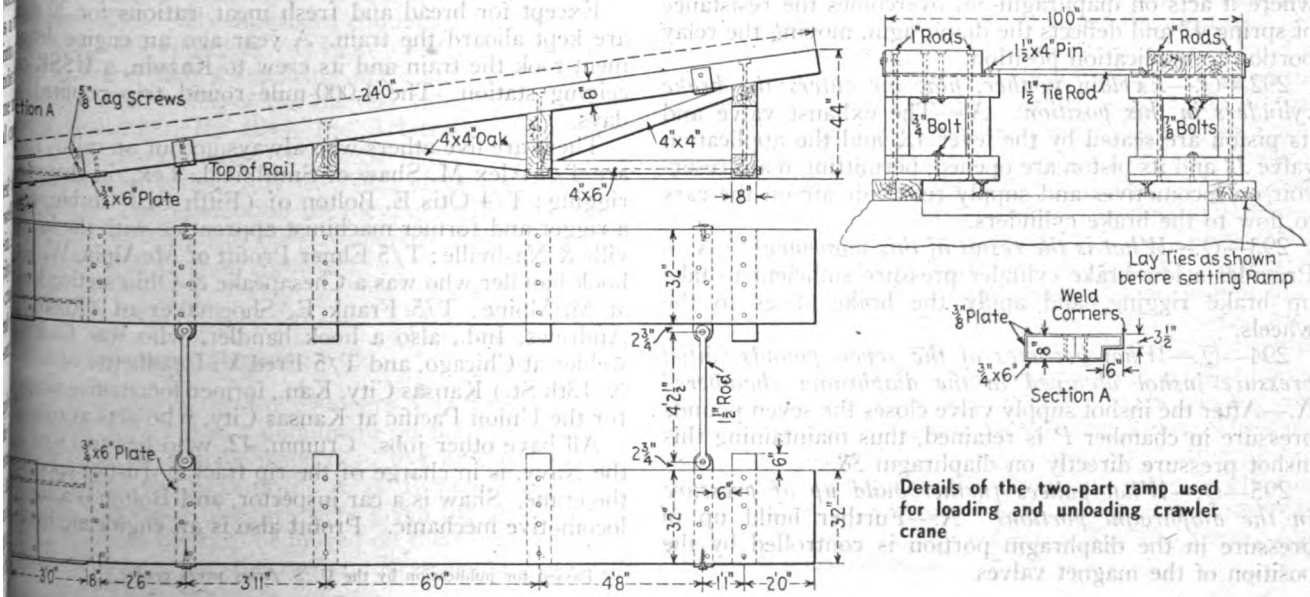
Referring to the drawing, it will be noted that the ramp consists of two built-up sections of well-braced, rigid bolted design, tied together by two 1½-in. steel tie rods. Each ramp section, constructed primarily of 8-in. fir timbers, is 24 ft. long by 32 in. wide. The cross bents and braces are made of oak and the lower end of each part of the ramp is iron clad with a 6-in. cut-out section to hold it in proper alignment with the rail.

In operation, the two ramp sections are simply swung into place at the end of the car with one side of each resting on the rail and the other blocked as necessary to bring it to rail-top level. The two tie rods are then applied, but no tie between the ramp and the car is necessary, as the crawler crane tends to pull the ramp and car together while either loading or unloading. The fact that





Above: Spare trucks on special flat car—At the left is wreck-train bunk car—Right: Northwest crawler crane with two-part ramp mounted on G. B. & W. flat car



Details of the two-part ramp used for loading and unloading crawler crane

both the crane and the two-part ramp are carried on the same car makes this unit both flexible and self-contained and it can be operated with a minimum of manual labor. The crane itself weighs 80,000 lb. and has a normal rated capacity of 21 tons. It is powered with an internal combustion engine and used primarily for light wrecking operations.

The bunk car and a flat car with spare trucks which normally accompany the wreck train are also illustrated. The bunk car was converted from a mail-baggage car and is completely equipped with the usual accommodations for the wreck-train crew. The 50-ton flat car used for carrying spare trucks has a steel underframe with 3-in. treated-oak decking, provided with wood strips to hold the trucks against transverse movement on the car deck. End blocking is supplemented by chains applied to each truck and secured to side anchor bolts by quick-acting lever clamps and locks.

These trucks are sprayed with a light-colored paint to identify them and to make sure that they are returned to the wreck train after temporary use under other equipment. Other cars used in the wreck train include a blocking car and a tool car.

Air Brake Questions and Answers

HSC Equipment on Passenger Cars and Diesel A and B Locomotive Units Brake Application

291—*Q.—How does the inshot valve portion function in order to move the relay portion to application position?* A.—At the inshot valve portion, application air from passage *16c* flows past supply valve *92* to chamber *C* on diaphragm *85*, thence to passages *15* and *15a*. From passage *15* the flow continues through chokes *138* and *140*, thence past upper magnet valve *161* and *161b* to passages *18* and *19*, passages *18a* and *19a* to the two diaphragm chambers *N* and *P*. When approximately seven pounds pressure is obtained in chamber *C* of the inshot portion, inshot diaphragm *85* is deflected, compressing spring *88* and moving piston *84* sufficiently to permit spring *94a* to seat supply valve *92*, cutting off further flow to diaphragm chambers *N* and *P*. The seven pound initial pressure inshot thus obtained in the diaphragm chambers is directly effective in chamber *P*, where it acts on diaphragm *38*, overcomes the resistance of spring *42* and deflects the diaphragm, moving the relay portion to application position.

292—*Q.—Explain further, how air enters the brake cylinders in this position.* A.—The exhaust valve and its piston are seated by the lever *43*, and the application valve *32* and its piston are opened, permitting main reservoir on locomotives and supply reservoir air on the cars to flow to the brake cylinders.

293—*Q.—What is the result of this movement?* A.—Provides a low brake cylinder pressure sufficient to take up brake rigging, and apply the brake shoes to the wheels.

294—*Q.—What becomes of the seven pounds initial pressure inshot obtained in the diaphragm chambers?* A.—After the inshot supply valve closes the seven pounds pressure in chamber *P* is retained, thus maintaining this inshot pressure directly on diaphragm *38*.

295—*Q.—What polices further build up of pressure in the diaphragm portion?* A.—Further build up of pressure in the diaphragm portion is controlled by the position of the magnet valves.

296—*Q.—At train speeds of less than 20 m.p.h., how does the speed governor react?* A.—At speeds of less than 20 m.p.h. the speed governor closes the circuit to the low speed (*L*) magnet, energizing its coil.

Wreck-Train Activities in Iran*

Arak, Iran—"Home" to T/3 Otis E. Crumm of Chico, Tex., and T/4 Gideon Justice of Grundy, Va., is a railroad car on a wreck train at Arak in faraway Iran.

They live in one of two cabin cars so that, if a wreck occurs on the Iranian State Railway, operated by the U. S. Army's Third Military Railway Service, the train can leave on almost a moment's notice.

It is one of four in the Persian Gulf Command. All are stationed at strategic spots along the 642-mile route of the single-track railroad over which the bulk of more than 5,000,000 tons of war supplies have been moved to the USSR in the last two years.

Sgts. Crumm and Justice keep the 75-ton crane's boilers fired 'round-the-clock, for the derrick is also used in other work, such as in the dismantling and assembly of Diesel locomotive trucks, on the rip tracks in the yards.

A former crane operator at the Ford Motor Company's giant River Rouge plant at Dearborn, Mich., Crumm has been on every wreck train in the command and the Arak train since March, 1943. Justice is a coal miner who learned to be a crane operator at Camp Claiborne, La.

The train consists of two cabin cars, one equipped to sleep eight; a kitchen car, a tool car, a fuel and water tender, the 75-ton derrick, and the block or idle car under the boom. Its territory is from Arak north to Qum, midway point on the ISR's northern division. However, it has aided in clearing the line as far south as Andimeshk and north to Kazvin and above Teheran on the Bandar Shah line.

The wreck crew's biggest job came last September when 27 cars and their cargo left the rails, overturned and burned between Arak and Samagan, ripping up 2,000 ft. of track. Twenty hours were spent in clearing the line.

Recently, the train and its personnel—10 enlisted men and officer go out on calls—assisted the 342d Signal Service battalion in repairing communications lines blown down in a blizzard in the mountains of Nourabad, at 7,272 ft., the highest point on the railroad.

Except for bread and fresh meat, rations for 30 days are kept aboard the train. A year ago an engine derailment took the train and its crew to Kazvin, a USSR receiving station. The 1,000-mile round trip required 15 days.

There are five others who always go out on calls. They are T/4 Alex M. Shaw of Smithfield, Tex., in charge of rigging; T/4 Otis E. Bolton of (Fifth St.) Corbin, Ky., a rigger and former machinist apprentice with the Louisville & Nashville; T/5 Elmer Profitt of McAlpin, W. Va., hook handler who was a Chesapeake & Ohio section hand at McAlpine; T/5 Frank E. Shoemaker of (Route 1) Andrews, Ind., also a hook handler, who was C. & O. welder at Chicago, and T/5 Fred V. Leadbetter of (3003 N. 13th St.) Kansas City, Kan., former locomotive painter for the Union Pacific at Kansas City, who acts as cook.

All have other jobs. Crumm, 42, who has two sons in the Navy, is in charge of the rip tracks. Justice operates the crane. Shaw is a car inspector, and Bolton is a steam locomotive mechanic. Profitt also is an engine mechanic.

* Passed for publication by the U. S. Army press censor.

Shoemaker is a welder, and Leadbetter is a light repairs crick foreman in the enginehouse.

The other three men are recruited from those available. Either 1st Lt. Robert J. Rush of (Route 1) Westville, Ill., or Capt. Charles F. Gilpin of Rock Springs, Wyo., accompanies the wreck train on its trips. Rush, an enginehouse foreman for the Chicago & Eastern Illinois, has been in Arak since last August. Gilpin, with the Union Pacific for 27 years and mechanical foreman for the Line at Rock Springs, is in charge of the Arak enginehouse. He also is commanding officer of detachments at Arak of the 791st Railway Operating Battalion.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Repairs Billing Limited By Depreciated Value of Car

The Texas & New Orleans and the Southern Pacific have an agreement whereby cars of either ownership may be given heavy repairs in the shops of either company. The Southern sent a damaged Southern Pacific stock car to a Texas & New Orleans shop attaching its defect cards covering accident damage. Later it received a copy of a joint inspection certificate and additional defect cards were requested for items of uncarded damage. The cards were issued and the later billing on their authority amounted to $262.13. Subsequently it was developed that the depreciated value of the car in question, less value of salvage, was $41.35. The Southern, accordingly requested the Texas & New Orleans to furnish counterbilling authority in the amount of $220.78 to adjust the overcharge it claimed on the basis of its interpretation of Paragraph (1b), Section A, Rule 112. The Texas & New Orleans declined to furnish the counterbilling authority as it did not consider that there was any overcharge, basing its contention on the decision in Arbitration Case 1029. The Southern contended that this decision was made obsolete by Item (1-b), Section A of Rule 112, and that a repairing line's bill cannot exceed the depreciated value of the car less value of salvage.

On November 16, 1944, the Arbitration Committee held that, "Paragraph (1-b) of Section A of Rule 112 as modified effective July 1, 1942, abrogated Decision No. 1029. The contention of the Southern Railway is sustained." *Case No. 1804, Southern Railway versus Texas & New Orleans Railroad.*

Billing for Home Movement Repairs

Ten cars belonging to the Shippers' Car Line Corporation were damaged in a derailment on the Texas & New Orleans. After a joint inspection, five of the cars were settled for on the basis of the A. A. R. depreciated value and the remaining five cars were given the necessary repairs to enable them to be moved on their own wheels to shops designated by the owner. Responsibility for the cost of these repairs was the issue in the case. It was the contention of the owner that the repairs made by the railroad were required because the cars had been involved in an accident and that they were of a permanent nature and were, therefore, the responsibility of the railroad. The owner further contended that none of the subsequent repairs made in its contract shops included any of the items covered in the repairs made by the Texas & New Orleans. The railroad contended that defect cards issued by it support its claim that some of the repairs which it made were temporary in nature and others improper repairs. Its action, according to the railroad, was intended as a favor to the owners in returning cars to service as quickly as possible and on saving transportation costs which would have been involved if the damaged cars had been loaded on other cars for shipment to designated shop points. It pointed to certain of the correspondence about these cars as indicating that it had no intention of absorbing the cost of the partial or temporary repairs, which on all five cars exceeded the $50.00 limit set up in Rule 112 governing repairs to damaged equipment to permit moving it to home shops.

In a decision rendered on November 16, 1944, the Arbitration Committee ruled that, "As the total cost of repairs to unfair usage damage did not equal or exceed the depreciated value of car less salvage, under the Interchange Rules the Texas & New Orleans Railroad may charge only for repairs made to owner's defects. *Case No. 1803; Shippers' Car Line Corporation versus Texas & New Orleans Railroad.*

Overload Damage

Missouri Pacific fixed-end gondola car No. 71008 while traveling on a Baltimore & Ohio waybill broke down under load on the New York Central. The car was loaded with steel bars, six bundles to each end of the car with the bundles overlapped in the center. The total load was within the load limit capacity of the car but there was a question as to whether an undue concentration of weight occurred at the point where the bundles were lapped. The case was first submitted to the joint committees, Car Construction and Loading Rules and it was agreed that the wording of Loading Rule 4 was not clear and that certain modification and clarification was needed in the reading of Section B. No agreement could be reached by the parties as to the proper interpretation of Loading Rule 4 and responsibility under Interchange Rule 32, Paragraph (10-h), and the case was submitted to arbitration. It was the contention of the Baltimore & Ohio that the car was loaded in accordance with provisions of the existing loading rule. The New York Central pointed out that the method of loading created a concentration of load at the lapped section bearing pieces which exceed the 40 per cent permissible load concentration provided for in Loading Rule 4 for a distance of 10 ft. long or less. It asked for offset protection on the defect card which it had issued and payment to itself for the cost of transferring the load.

The Arbitration Committee decided on November 16, 1944, that, "Loading Rule No. 4 prohibits loading in excess of 40 per cent of the stenciled load weight limit over a space of 10 feet or less in fixed-end gondola cars. MP car 71008 was loaded to 48 per cent of the stenciled load weight limit over a 7-ft. bearing-piece spread Therefore, the car was overloaded. This opinion has the concurrence of the Committee on Loading Rules. The damage is the responsibility of the originating road haul carrier, as provided in Rule 32, Paragraph (10-h). The contention of the New York Central Railroad is sustained." *Case No. 1805, New York Central Railroad versus Baltimore & Ohio Railroad.*

Year of Train Telephone Tests

The conductor talks to the engineman

By W. W. Pulham*

Rio Grande reports on results obtained with different types of equipment operating under wide variety of conditions

To the uninitiated radio communication between the engine and the caboose on freight trains might seem a relatively simple facility to install. The Rio Grande, however, after testing and experimenting for a year, has found and is now coping with many problems which must be overcome before we can have 100 per cent communication between the engineer and the conductor, and at the same time not interfere with other proposed radio services. Some of the problems presented are the result of difficult terrain over which our railroad operates between Denver, Colo., and Salt Lake City, Utah.

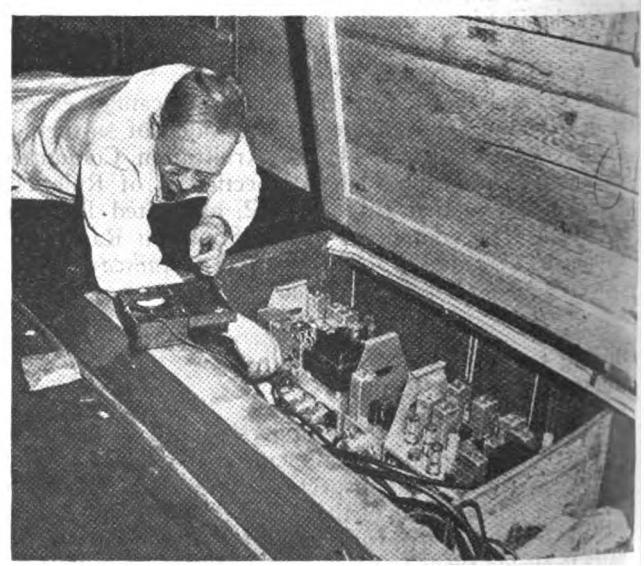
There are 50 tunnels in the 570 miles of main track between these two terminals, ranging in length from 100 ft. to 6.2 miles (Moffat tunnel). Thirty of these tunnels fall within 35 miles, on part of the 129-mile stretch where the Rio Grande operates over the Denver & Salt Lake trackage on the Dotsero cut-off route. In addition to these obstacles to communication, there are cuts, winding canyons, and extremely rugged terrain. On the other hand, between Grand Junction, Colo., and Helper, Utah, the railroad passes through relatively flat, open country.

One of our biggest problems becomes that of having sufficient power to overcome extreme attenuation in the mountainous country, and at the same time not so much power that too great a distance is covered in open country, which would tend to create a congestion of air traffic and consequent interference with other proposed services.

* Superintendent of Communications, Denver & Rio Grande Western, Denver, Colo.

Started Test in April, 1944

We made our first test run early in April, 1944. At that time, police emergency radio equipment was used, operating in the 30-40 mc band, frequency modulated, and with a power output of 60 watts. The installation was made on a fast-freight train of 65 cars out of Denver, and increased to 85 at Grand Junction. It was estimated by the train crews that the time saved in closing switches, stopping to cut out a bad-order car, release of sticking brakes observed by the rear end, highballs from the rear, and over-all operating handled by radio, amounted to approximately three hours from Denver to Salt Lake. Communication was maintained continuously with the exception of within the Moffat tunnel and in two of the longest minor tunnels. Several problems were disclosed, however, that would have to be solved before we were ready for regular installation. In the first place, it was improbable that the F.C.C. would be able to give us a license in the 30-40 mc channel. We had reason to believe that the power was too great for open country work, and we failed to obtain communication through all the tunnels. Another major problem was



Transmitter and receiver as installed in a caboose

East portal of the 6.2-mile Moffat tunnel

that of supplying cabooses with suitable and adequate power for the operation of the radio equipment.

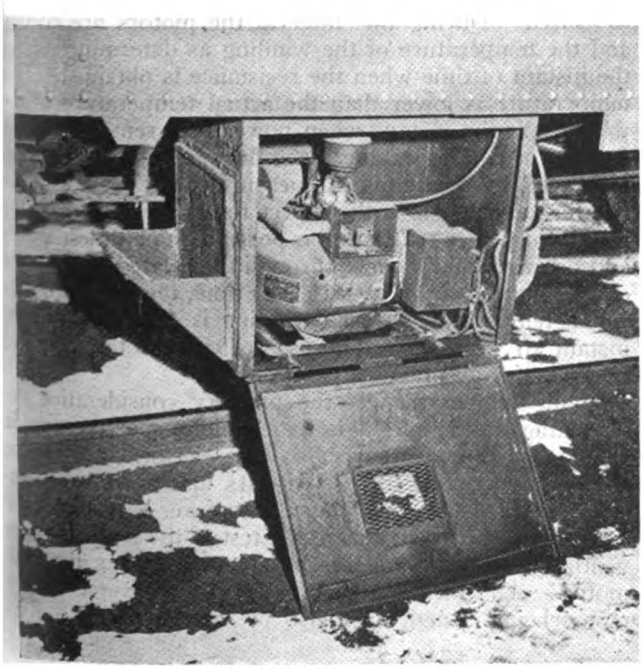
Various Other Tests Made

Since that time, many test runs have been made with a number of different types of equipment, to determine what type of modulation, transmitter power, type of antenna and radiation, receiver sensitivity, and frequency would be best suited to do a satisfactory communication job from engine to caboose.

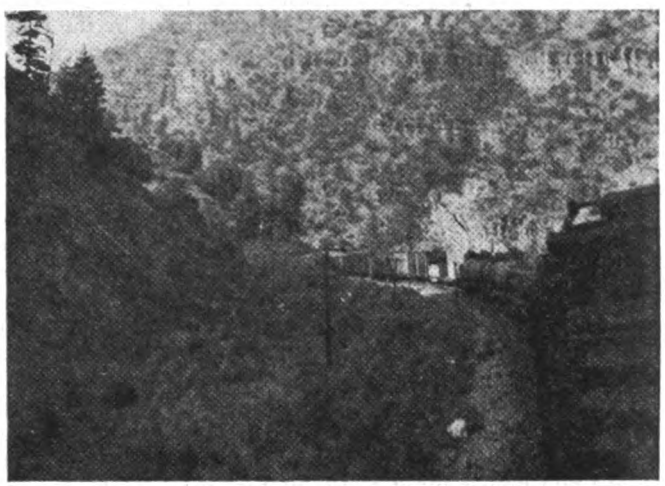
We have used amplitude modulation, frequency modulation and phase modulation; we have operated in the 30-40, 117, 156 and 2,700 mc bands; we have used power ranging from 6 watts to 60; and have experimented with a number of antenna types from a simple ¼ wave-to-ground to intricate arrays. In addition, we have studied various types of power supplies for the cabooses.

It is interesting to note that in only one test have we successfully obtained communication through the Moffat tunnel. This was done with 15-watt phase modulation equipment operating in the 2,700 mc band. A multiple driven antenna array was used which gave us a low radiation pattern 360 degrees in extent. It is believed that the tunnel acted as a wave guide in this instance, which resulted in a stronger signal being received inside the tunnel than in open country transmissions. This performance would indicate a promising future for this frequency, but at the present time this type of equipment has not been developed on a commercial basis.

A decision between the use of AM and FM has become a problem. Both types are free from man-made static in the very high frequency range. The use of FM tends to give one station preference over a station somewhat further away from the receiving station, thus blocking out the latter. This is not true with AM, and there is a question whether this would be advantageous or not.



A gasoline-driven, 117-volt, a.c. generator mounted under the caboose



Mountain canyons along the Colorado River impose special problems

Engineman using a close-talking microphone employed with Galvin-Motorola tests made in March and April, 1945

Our studies have indicated that a radiating power of not over 25 watts combined with a high-gain receiver should be adequate for our mainline end-to-end service. A number of types of antennas do a very satisfactory job, especially those that are non-directional and radiate at a low angle. It is believed, however, that still more improvement can be made along this line, and we are continuing with our experiments in antenna design.

(*Continued on page 317*)

Temperature Governs Tonnage*

By J. W. Teker†

Method for obtaining full output of Diesel-electric locomotives without risking damage to insulation by cut-and-try methods

THE Diesel-electric locomotive does not know when to quit, nevertheless its ability to handle overloads is dependent upon the thermal capacity of the electrical apparatus so that the duration, for which a given overload may be maintained with safety, is determined by the temperature of the windings preceding its application. Where ruling grades, or speed of operation limit train weights, the load is generally below the continuous rating of the equipment so that low winding temperatures provide a useful margin of overload capacity. This is an advantageous attribute of the electric drive in railway operation when correctly utilized.

It is essential to know motor temperatures just preceding a given overload to be able to determine the permissible duration for such duty. Temperature measurements taken in the intended service will be a check on the assumptions made during application study. It is often hard to make proper assumptions of variables when making such studies for a difficult service. When steam helpers are required to move heavy trains over long grades, it is necessary at times to reduce Diesel-engine speed and power input to the motors in order to accommodate differences between the speed-tractive force characteristics of the steam and Diesel locomotives. If traction motor blowers are belt driven, the volume of ventilating air is then decreased so that even operation at the continuous rating may be questioned. Temperature measurements are useful to obtain data and checks on such operation.

Cut-and-try overload application methods in service on narrow margins without knowledge of apparatus temperature is an uncertain undertaking the inadequacy of which may not be immediately evident, but will show up in time by increased maintenance cost and frequent motor or generator failures. Severe overheating in a single instance may be sufficient to shrink wedges and relax bands, without causing immediate failure, but subsequent movement of the winding under influence of vibration will cause the insulation to wear through and fail by short circuit or ground even before complete deterioration of insulation is achieved.

Various means have been developed in the past to give a continual indication of motor temperature, but none has been favored by general use. Until such time as reliable temperature-indicating instruments are developed for railway use as to warrant general application, the measure of motor temperatures by the resistance method is the most reliable and accurate means available today. It is a recognized and familiar means of temperature determination by electrical apparatus manufacturers and is common on their test floors where the personnel is trained and skilled in its use.

This same method has been developed for the railway field by a series of evolutionary experiences until the technique and required skill have been reduced to a point where measurements can be made under these adverse conditions by an operator and the help of men unskilled in laboratory or test-floor methods. The results equal and sometimes surpass in speed, accuracy, and uniformity those obtained under more favorable conditions on the test floor, and it becomes a practical tool for genera field use where questions pertaining to motor tempera tures have a bearing on railway operation.

The method selected for determination of averag motor-winding temperature is dependent upon the know change in electrical resistance of a copper conductor wit temperature, and is expressed by the relation $T = (R/r (234.5 + t) - 234.5$. The initial, or cold resistanc r of each component winding in question is measure after the motors have stood without power long enoug to allow all motor parts to cool to a uniform ambien temperature, t, which is measured directly with mercur thermometers placed upon the motor parts and checke with each other and surrounding ambient temperatur The hot winding resistance, R, is measured at prear ranged stops on the main line with the train and at th point where the temperature of the motors in the actua service is questioned. The temperature, T, is then readil evaluated from the corresponding cold resistance, r, a temperature t.

It is necessary to remove power from the motors an bring the train to a stop before these resistances can b measured. During this interval the motors are coolin and the temperature of the winding as determined is fo the instant of time when the resistance is obtained. Thi temperature is lower than the actual temperature of th winding at the instant when power was removed by th amount of cooling taking place during this elapsed time However, by continuing to measure the resistance of th winding as it cools with respect to a time started at th instant of power removal, it is possible to plot these value and draw a cooling curve through the related points. B extending this curve back to zero time, the most probabl actual temperature of each winding is determined at th instant of power off, and is well within the limits o accuracy for all practical purposes.††

While temperature is the primary consideration de termining motor life, it is expedient to plot the data i terms of temperature rise so that performance can b compared between successive tests under different con ditions. Measurements must, therefore, be made of th ambient temperature during the test of the traction-motor ventilating air, as well as the air surrounding the loco motive. The volume of ventilating air delivered to each motor being tested must also be determined as well as

* Abstract of a paper recommended for publication by the Committee on Land-Transportation, American Institute of Electrical Engineers appearing in the July issue of Electrical Engineering.

† Engineer, General Electric Company.

†† American Institute of Electrical Engineers Standards ASAC 35.1—1943, 11-156, 158 and 159.

he power input to the motors so that rms current values an be calculated for the train tonnages hauled.

The success of the method outlined is dependent upon ractical means for making the necessary measurements nd upon a test crew organized and equipped to make iese measurements without causing serious loss of time) the scheduled run of the train.

The motor-field windings are connected to the instruient with temporary wiring and suitable switches so iat resistance measurements can be made quickly. The istrument station should be located in the cab as close) the motors as possible so as to hold length of the interonnecting leads to a minimum.

The armature resistance is obtained by selecting a span f the armature winding to which connection is made by ontacts spaced apart by the desired number of comiutator segments and held in fixed relationship by a pecial yoke applied by hand pressure to the commutator hrough the motor-inspection opening

Connection between contacts of the yoke and the intrument station is made through a multiple-wire flexible able long enough to reach through a cab window down) the motors in the locomotive truck. This equipment is oiled and carried in the cab between stopping points for ieasurements.

Communication System

A signal system is necessary between the man at the istrument station and the man in position at the motors /hen measurements are in progress because of their reiote location and the magnitude of noise level with Diesel engines idling. A push button fixed at the instrument station and a simple electric bell properly protected against injury during handling is used for this purpose, interconnected with flexible leads long enough so that it can be lowered from the cab to a man on the road bed. The signal code used is as follows:

One bell—make contact with yoke on armature.

Two bells—hold contact; measurement is in progress.

Three bells—remove contact.

An ammeter placed in the battery circuit of the bridge indicates as soon as a circuit is established through the armature and informs the resistance-bridge operator to proceed with measurement, while the man making the contact is informed to hold it by signaling two bells. A failure to establish contact with all four points on the commutator simultaneously is evidenced by failure of the ammeter to indicate if the current circuit is open or by an off-scale swing of the bridge if the voltage or drop circuit is open. In this case, the operator continues to call for contact by repeating the one-bell signal.

Commutator temperatures are measured with a contact type hand pyrometer. This is an open junction thermocouple instrument with inherent ambient compensated millivoltmeter reading directly in degrees centigrade.

Thermocouples made up from copper and copnic wire serve to measure the temperatures at remote locations inaccessible while under way, such as the roof and roadbed ambient temperature, traction-motor armature and axle bearing, frame, and air-out temperatures.

Power Input Measurement

The power input to the motors is measured with a voltmeter and ammeter with respect to time; the interval

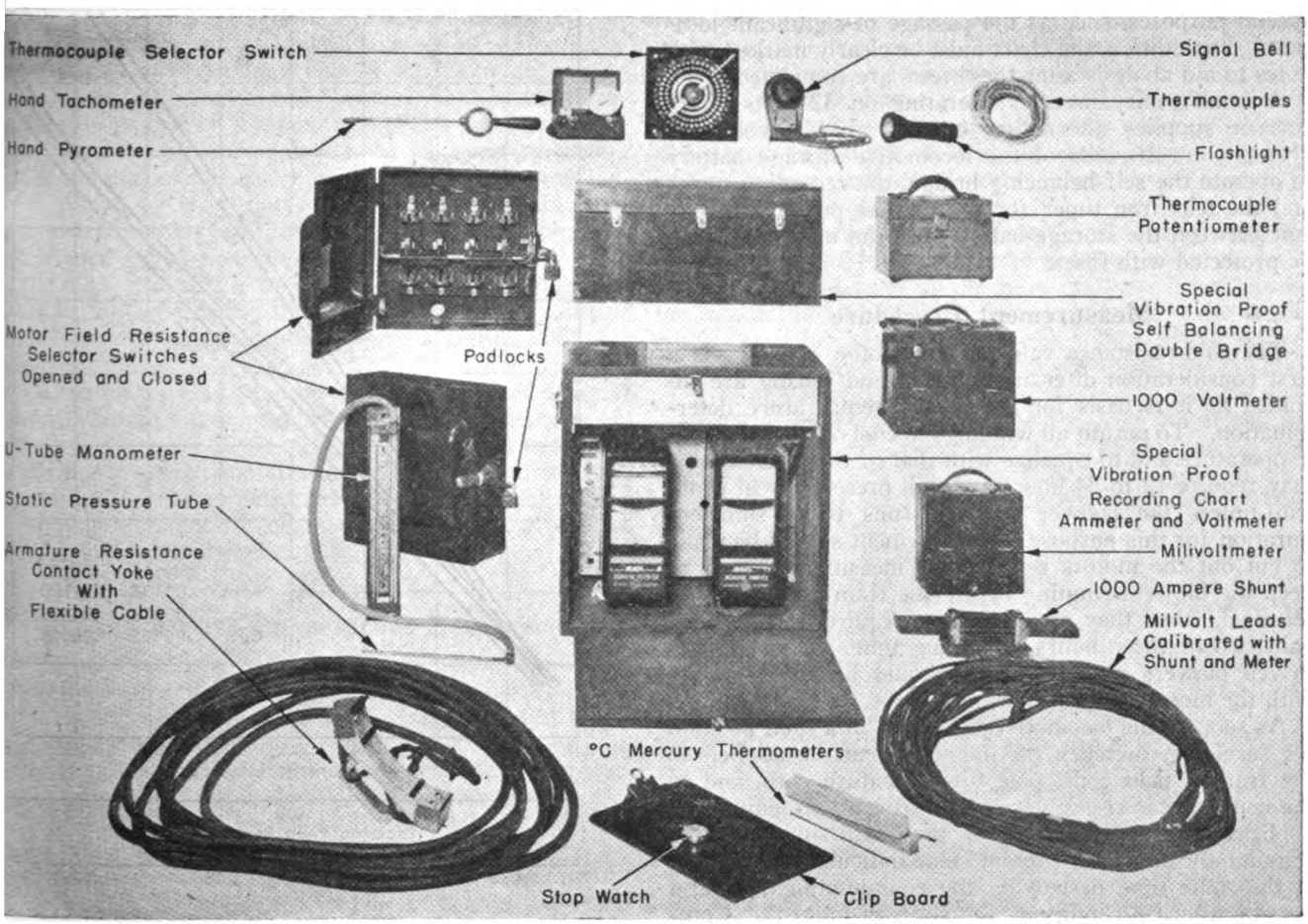


Fig. 1—Instruments and special equipment required for measurement of railway motor temperatures in service

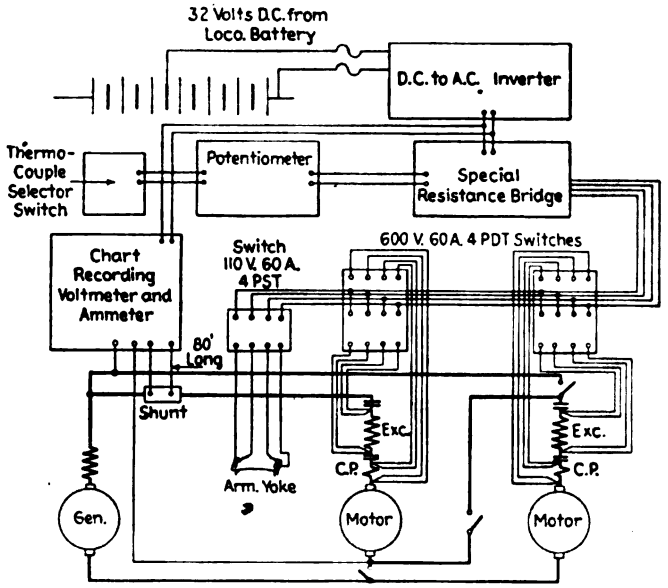


Fig. 2—Connection diagram for measurement equipment

of which is dependent upon the profile of the railroad and the operation being studied. This is a laborious and tedious procedure which may be eliminated by installing chart-recording instruments to keep a graphic record of the test. Recording meters should be equipped with special marker pens, energized periodically by means of a telechron-driven contact-making switch to put a reference mark in each graph. A push button should also be provided to permit operating the marker pens at will for special purposes, such as the passage of significant locations. In addition, the chart must be clearly marked with notes to aid analysis after these tests are completed.

A small rotary inverter operating on 32 volts direct current supplies alternating current at 110 volts, 60 cycles, from 16 cells of the locomotive storage battery to operate the self-balancing bridge, the recording meter and the telechron timer for the marker pens. The circuit between the storage battery and the inverter should be protected with fuses.

Measurement Procedure

The cold-resistance value of the motor windings is a first consideration after instruments and wiring are installed as it is basis for subsequent temperature determination. To permit all windings to cool off to a uniform temperature and to equalize with that of the entire motor may require 12 to 24 hours and will present a real problem unless the layover between runs is of sufficient duration for this purpose. Arrangement should be made to cut out the motors selected for measurement and to keep the blowers running before the train arrives at the terminal, when they are no longer required. This may gain two or three hours of cooling time. If electrically driven blowers are used, they should be kept running with the motors or power plant cut out.

As soon as the locomotive is spotted in a final position for servicing, mercury thermometers can be applied to the frames, field coils, pole tips, armature core, and to the commutator risers. It is well to caution against the application of putty directly on the brush surface of the commutator as it may present some difficulty in cleaning, at the same time destroying the commutating film and thereby altering conditions for subsequent tests. Comparative ambient temperature may be obtained by placing a thermometer on the track rail head with putty over the bulb, or by placing a thermometer in a small can filled with oil so as to stabilize fluctuation in air temperature when large doors are opened in the locomotive service shop or enginehouse, or with variable wind if standing in a railroad yard. Cold-resistance measurements can be started as soon as comparative observations of thermometers show reasonable agreement. Record the date, time, temperatures, with resistance values, and check at intervals.

When measuring armature cold resistance, the armature yoke should be applied on several alternative segment positions available and, after removing the armature thermometers, the locomotive may be moved sufficiently to present different sections of the commutator, the measurements on which should check reasonably with one another.

Cold-resistance readings should be again measured at the conclusion of all testing and checked with the initial readings to ascertain that no changes had occurred during the testing period. For this purpose, resistance values should be evaluated at 25 deg. C. as a ocmmon basic temperature for comparison.

The work of reading temperatures will be greatly facilitated by drawing temperature resistance curves for each winding in each motor being tested (Fig. 3). Since this curve is a straight line within the range of temperatures under consideration, it is only required to plot the cold-resistance values at their measured temperature and calculate the value of resistance for 200 deg. C. as being the extreme value when hot. A straight line is drawn through these two points and any intermediate value can be read directly from the curve.

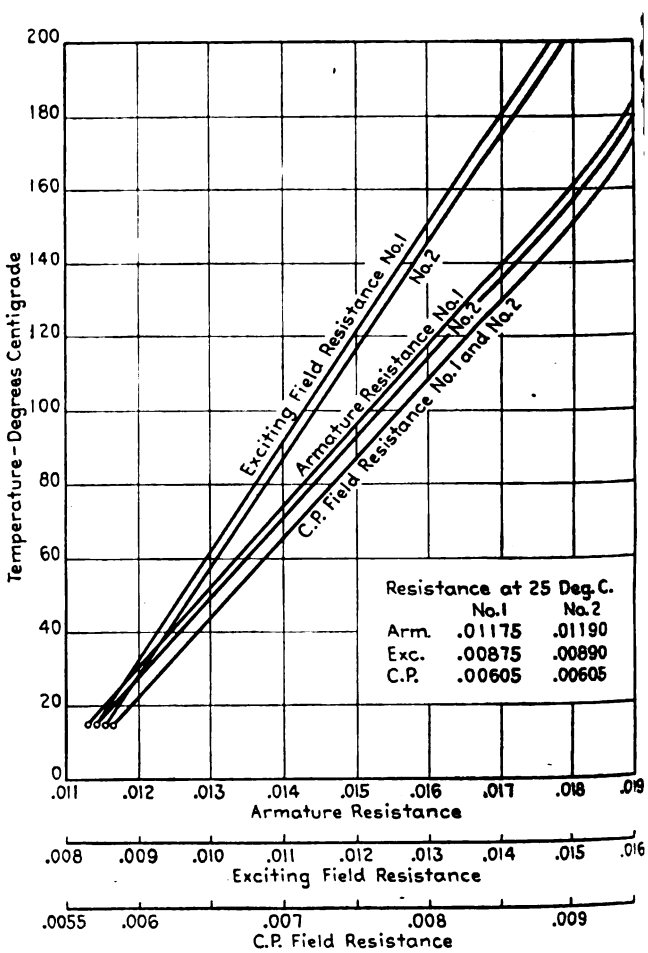
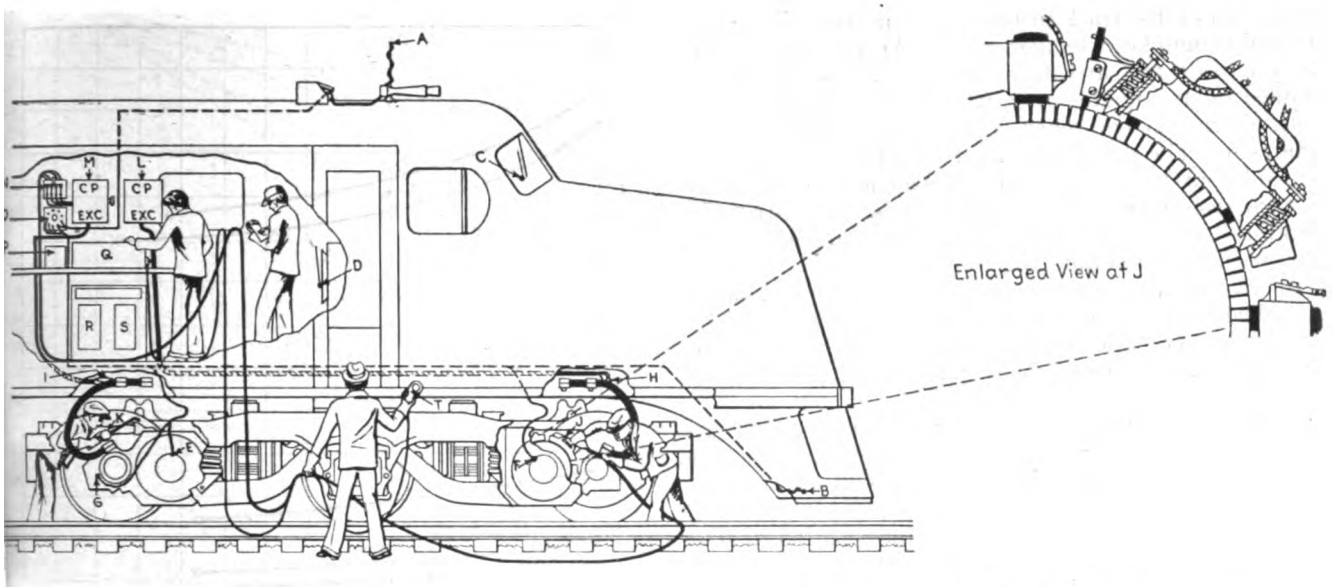


Fig. 3—Typical temperature-resistance curves for motors No. 1 and No. 2



A—Roof air temperature T.C.
B—Road-bed air temperature T.C.
C—Windshield air thermo
D—Traction motor blower air in thermo
E—P.E. armature-bearing temperature T.C.
F—C.E. armature-bearing temperature T.C.
G—Axle-bearing temperature T.C.
H1No. 1 motor field resistance leads
I—No. 2 motor field resistance leads
J—Armature resistance yoke

K—Commutator temperature pyrometer
L—No. 1 motor field resistance selector SW
M—No. 2 motor field resistance selector SW
N—Armature resistance switch
O—Thermocouple selector SW
P—Thermocouple potentiometer
Q—Vibration-proof double bridge
R—Recording voltmeter
S—Recording ammeter
T—Signal bell

Fig. 4—Position of personnel when taking temperature measurements

The air delivered to the motors by the blower is best measured by drilling the commutator inspection cover to admit a static pressure tube into the commutator chamber; then read the air pressure in inches of water on a manometer. The readings should be taken at idling, one-half and full speed of the blower. At the same time measure the speed of the engine. When tests are concluded, engine and blower speed should again be measured to see that conditions remained the same during the testing period. Record date, time, speed, temperature of air at blower intake, and barometric pressure, if the date is to be used for comparative reference.

A similar procedure for electrically driven blowers should be followed except that speed would be dependent upon blower voltage instead of engine speed as with the belt-driven blower.

The volume of air to the motors is determined from a pressure-volume curve usually available for the type of motor being tested. If not available, one can be prepared by blowing a similar motor through a calibrated pipe to determine the volume delivered for corresponding pressures in the commutator chamber as outlined by blower manufacturer's testing code.

Making the Service-Temperature Measurements

Before the test run is made the locomotive should be moved from over the service pit onto a section of track similar to the main-line road bed. Assign the test crew to their stations and outline the testing procedure and the duties for each station. The entire sequence of the test should next be rehearsed, including the making of measurements, and the entire operation timed from start to finish. This practice will prove invaluable to the men by relieving tension and instilling confidence and teamwork in preparation for the actual measurements on the main line.

The following program of events is performed in sequence (Fig. 4):

1—Just preceding the arrival at the designated stop for heating measurements, a prearranged signal from the head end is given when power is no longer required to make the stopping point. Padlocks are removed from the switches, and all equipment is made ready.

2—As soon as power is shut off at the head end and the engines come to idling speed, a stop watch is started at the instrument station, and the electric-driven blower or the Diesel engine belted to the blower, as the case may be, is shut down completely.

3—As soon as the train comes to a stop it is made safe (removal of reverser handle or other means to lock power off) by a man at the head end who then leaves the cab and takes a position on the road bed at the truck while two other men, one for each motor, climb under the locomotive and remove the motor-inspection covers.

4—While part 3 is taking place, the two men at the instrument station unwind cables and pass the armature yoke, signal bell, and pyrometer down to the man on the road bed adjacent to the truck, who retains the bell and gives one man at the motors the resistance yoke and the other the pyrometer.

5—Resistance measurements are made in the following order by two men at the instrument station: (a) Motor No. 1 commutating field, then exciting field, followed by the field measurements on motor No. 2.

(b) Signal for armature contact to be made and held on No. 1 armature while No. 2 commutator temperature is measured. Signal as soon as resistance is obtained and the man on the road bed will pass the yoke from No. 1 motor to No. 2 and the pyrometer from No. 2 to No. 1 and make a record of commutator temperature. As soon as contact is established on No. 2 armature, the instrument station will acknowledge by signal to hold contact while resistance is measured, after which the concluding signal is given. Meanwhile record is made of No. 1 commutator temperature.

(c) The fields of motors No. 1 and No. 2 are again measured while the yoke and pryometer are exchanged

by the man on the track in readiness for repeating armature and commutator temperatures. At least three readings on fields and armatures of each motor should be obtained in six minutes' time from the instant the power is off, which may be broken down into an average of two minutes to make the stop and get the first armature contact and four minutes for all subsequent measurements. As each resistance value is called off by the instrument operator, the other man notes the time and enters the value on a prepared data sheet.

6—As soon as measurements are concluded, the cables are pulled into the cab, motor covers replaced, and both men climb from under the locomotive. When all is clear the shut-down engine or blower is started and the run is resumed.

7—The commutator temperatures which were recorded by the men on the track are transferred to the data sheet at the time values corresponding with the opposite motor's armature-resistance values.

8—During the run, and especially for a period of time preceding a stop for winding-temperature measurements, readings are taken and recorded in the log of air temperature on the roof, road bed and at traction-motor blower intake. Readings are also made periodically of motor frame, air out and bearing temperatures. The chart recording meters are inspected to see if they are inking and calibration is checked with readings on the indicating meters. At the head end of the locomotive, windshield temperature, speed, location on the railroad, and controller-notch position are recorded with respect to time so that it may be related with the readings in the test log.

For the purpose of obtaining these readings, the test crew is reassigned to secondary duties so as to have a division of labor but insuring coordination of all data at one point. The train consist in tons and number of cars for each test run should be recorded with the train identification and direction of travel.

Determination of Operating Temperature

The resistance value can be read off directly as temperature from the resistance-temperature curve and, by subtracting the motor blower air-in temperature, the rise of the winding is obtained, corresponding with the time of measurement. These values of rise are plotted with respect to time and a smooth exponential curve is drawn through related points to zero time and the intercept with the temperature axis is the most probable temperature rise of the corresponding winding at the instant of power removal (Fig. 5). The importance of getting the first readings as soon as possible after power off becomes evident, for it minimizes the extent of extrapolation of the curve.

The cooling-curve technique is also applied to the hand pyrometer commutator temperature readings to arrive at the probable rise just before power off.

Occasionally, circumstances will prevent immediate measurement of armature resistance and a prolonged cooling period will result before the first reading is obtained. The extrapolation of these delayed data to zero time is aided by the use of average armature cooling curves (Fig. 6). These curves are prepared from factory test data on the same type of motor for several different conditions of power input, and are expressed in terms of per cent temperature rise with respect to time. Generally, heavy loads of short duration have steeper cooling-curve shapes than continuous runs. This is caused by the steep temperature gradient between the copper and the iron core which lags behind during the short heating-up period, whereas

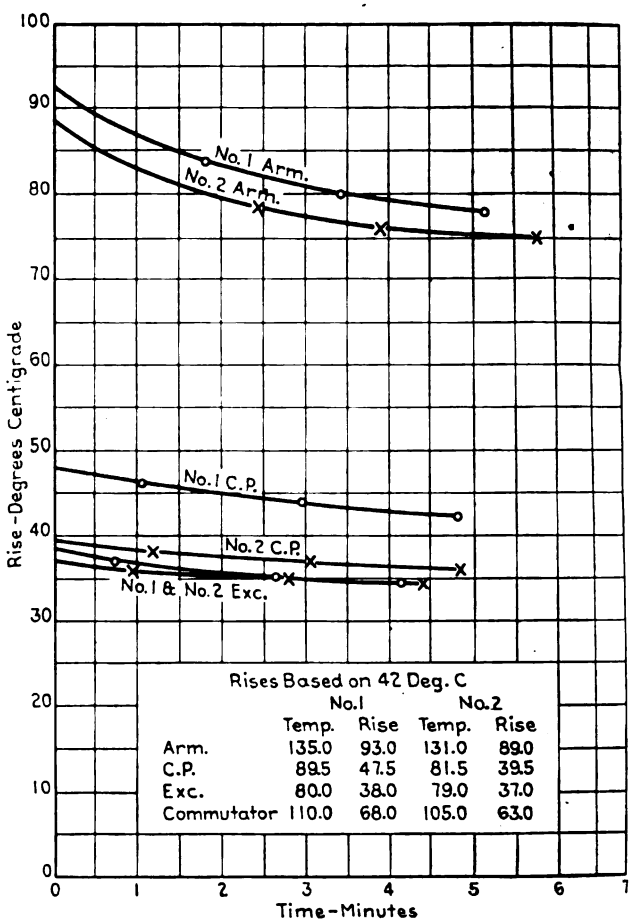


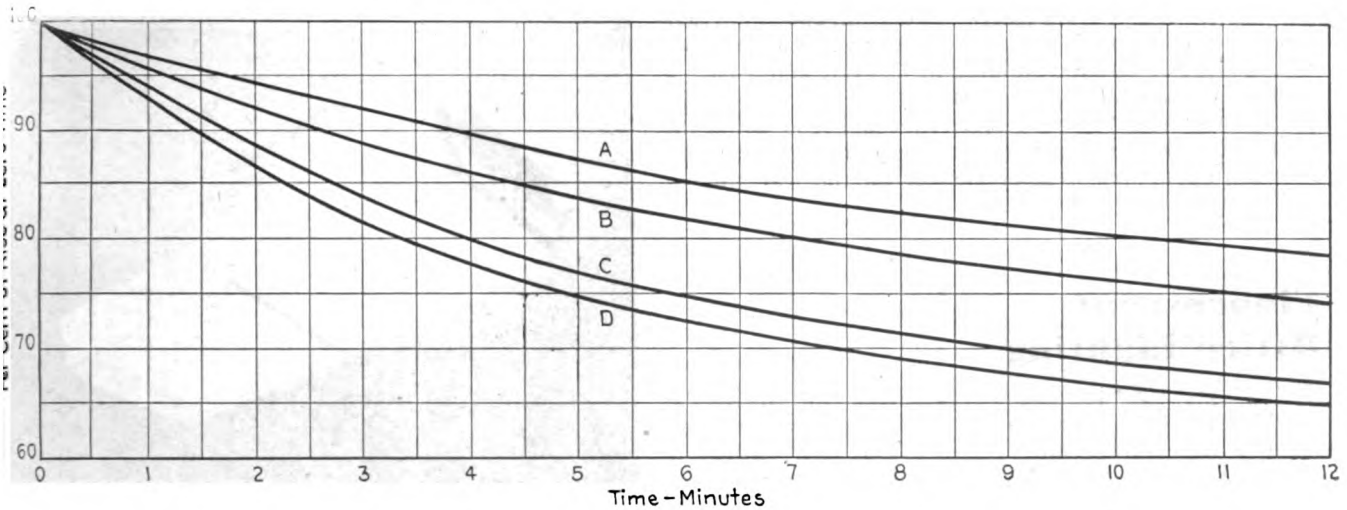
Fig. 5—Typical cooling curves—Total train weight, 1,224 tons (13 cars plus locomotive), rms current, 449 amp. for 67 min. or total distance of 81 miles

during a continuous run their temperature becomes more nearly equalized.

The proper cooling shape is selected by evaluating the power input for the period preceding the shut down in service and identifying it with a corresponding curve shape, or by interpolating between the two curves coming closest. From this curve is read, for the elapsed cooling time at which the first service reading was taken, the percentage value of the actual measured temperature rise, from which is prorated the 100 per cent value at zero time.

The rms (root-mean-square) current value is obtained from the chart made by the recording ammeter by dividing the graph into intervals of time, and the average current value for each interval is squared and multiplied by that time interval. The sum of these products is divided by the total time to get the average current squared for the run. The square root of this value is the rms current value for the test.

It is not always practical to obtain the full desired train tonnage without delaying the test, or during the test run it may be desired to check performance with one power plant hypothetically broken down. These situations can be approximated by purposely reducing the locomotive power by multiples of the number of motors until the desired prorated train tons per motor is obtained. The temperature measurements are then made under this artificial condition. For example, if two out of eight motors are cut out, of a locomotive in an 18-car test train having a combined weight of 1,680 tons, the load per motor will be increased from 210 to 280 tons. The heating of the motors would then be equivalent to that of a 24-car train of 2,240 tons total weight.



	Amperes	Revolutions per min.	
A—	650	1,300	Continuous
B—	675	778	Continuous
C—	1,000	450	30 min.
D—	1,130	374	13 min.

Fig. 6—Average armature-cooling curves obtained from heat-run data

The method, procedure, and equipment are also applicable to measurements of generator temperature which can be made in a multiple-unit locomotive by shutting down the one power plant for a few minutes to obtain measurements without the necessity of stopping the train.

The recording-chart instrument with calibrated meters affords data on engine horsepower output by reference to a generator characteristic for the generator efficiency values over the operating range from which the horsepower input to the generator can be calculated.

Temperature of locomotive electrical apparatus is more than a question for academic consideration; it is an active economic factor, never at rest and continually exerting its influence with time on the life of the equipment. The penalties of rash application or abusive operation are inescapable.

The effect of elevated temperatures on organic insulation materials follows the approximate rule of half the life for each 8-12 deg. C. increase in temperature.* The indisputable and direct approach to correct utilization or application of motive power is with a full knowledge of electrical apparatus temperature. The testing facilities and method outlined provide these necessary data for railroad operating and motive-power departments, as well as engineering information of application and design value. It is a means whereby a railroad can take the measure of its tough spots and the engineer correct his shots.

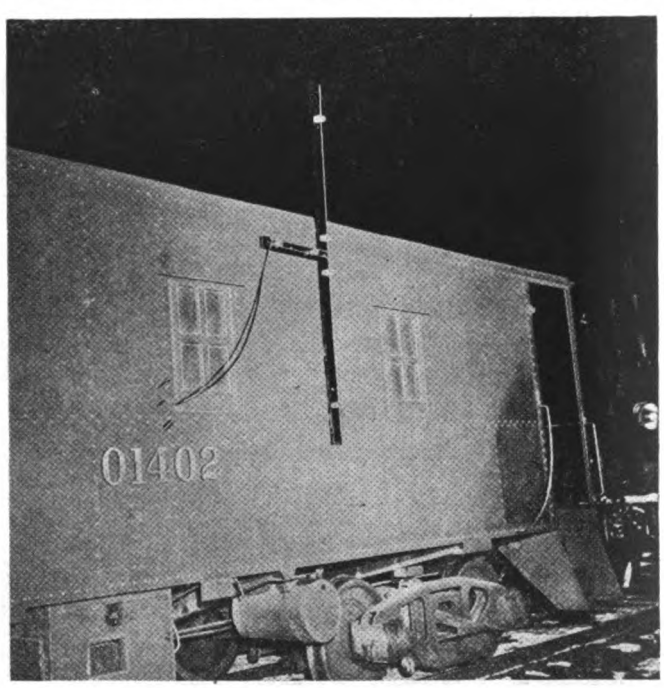
*Report No. 1A, September, 1941, "Report on General Principles for Rating of Electrical Apparatus for Short-time, Intermittent, or Varying Duty."

Year of Train Telephone Tests

(*Continued from page 311*)

The problem of power for cabooses has proved to be an interesting one, and there are two schools of thought on the subject. One favors the axle-driven generator type, similar to that used on passenger cars, except on a smaller scale. The other believes the internal combustion engine-driven generator to be the better of the two types of power. We are studying both kinds of power from the standpoint of initial cost, maintenance cost, out-of-service time, dependability, and amortization time. For the benefit of those who are skeptical of the engine-driven power, we can certainly commit ourselves to the extent that performance is very satisfactory and relatively trouble-free. We have operated one unit for more than 500 hours with one spark plug failure being the only trouble encountered. Inasmuch as the engine is a two-cylinder horizontally opposed type, the remaining cylinder continued to operate the generator for five hours until a terminal was reached, and no power failure resulted. Communication was maintained with no apparent loss of power.

Studies also are well under way on the Rio Grande



Type of two half-wave, in-phase antennae used for the Galvin-Motorola tests

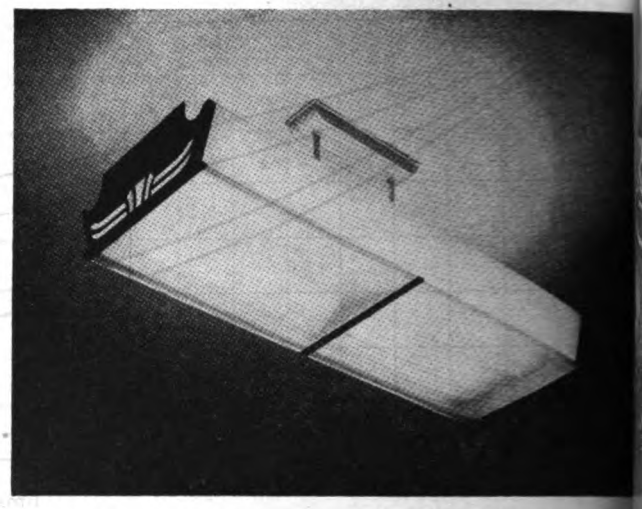
for train-to-station communication by radio. It is planned to operate from fixed stations with an antenna in the most advantageous point as practical, with remote control, if necessary, to the operations office. In open country this should be relatively simple. In the mountainous area, it is anticipated we will probably find that numerous relay stations will be required to carry the communique the required distance from trains to the station.

On April 17, we conducted a test of train-to-station two-way radio telephone equipment, operating between a station in the Rio Grande building in Denver, and a freight train. Conversation was satisfactory not only while the train was in the yard at Denver but also while the train proceeded for a distance of approximately 30 miles into the mountains west of Denver on the way to Salt Lake City.

Fluorescent Office Lighting

The Jersey Central Accounting Office shown in the illustration affords good fluorescent lighting accomplished by means of individual fixtures. The office which is about 1,000 ft. long and 50 ft. wide, a year ago consisted of a number of small offices with ceiling height partitions on either side of a central corridor, lighted with a miscellaneous assortment of 200-watt incandescent fixtures. At that time, the partitions were removed and the new lighting system installed. A second office in the same building which is about 300 ft. shorter than the one shown, is similarly lighted.

The fixtures are Mitchell Manufacturing Company. U. R. C. units, consisting of metal frames and corrugated glass panels, each containing four 40-watt 3,500- deg. F, white, fluorescent lamps with two-lamp auxiliaries. Each unit has a fixture switch operated by a pendant cord. The lighting units are four feet long and 18 inches wide. They are placed on 14 ft. centers longitudinally and 10 ft. centers laterally, making the distance from edge to edge between fixtures approximately 10 ft. The mounting height is 9 ft. from the floor to the bottom of the fixture.



A close-up of one of the fixtures used in the office, shown in the other illustration

Ceilings are finished a flat white and the side walls flat light green, with darker green trim. Lighting intensity on a horizontal plane, 30 in. above the floor, as installed was 30 foot-candles with almost no measurable variation.

There are four units on each circuit and the minimum wire size is No. 12. Distribution of individual circuits is made from Bulldog deadfront safety panels, with a single Buss Fustat in each circuit. These fix the size of fuses which can be applied. In this case, 15-amp. fuses are used on each four-fixture circuit. There are a total of 225 units in the two offices which are located respectively on the second and third floor of the Express building.

Fluorescent-lighted office of the Jersey Central located in Jersey City, N. J.

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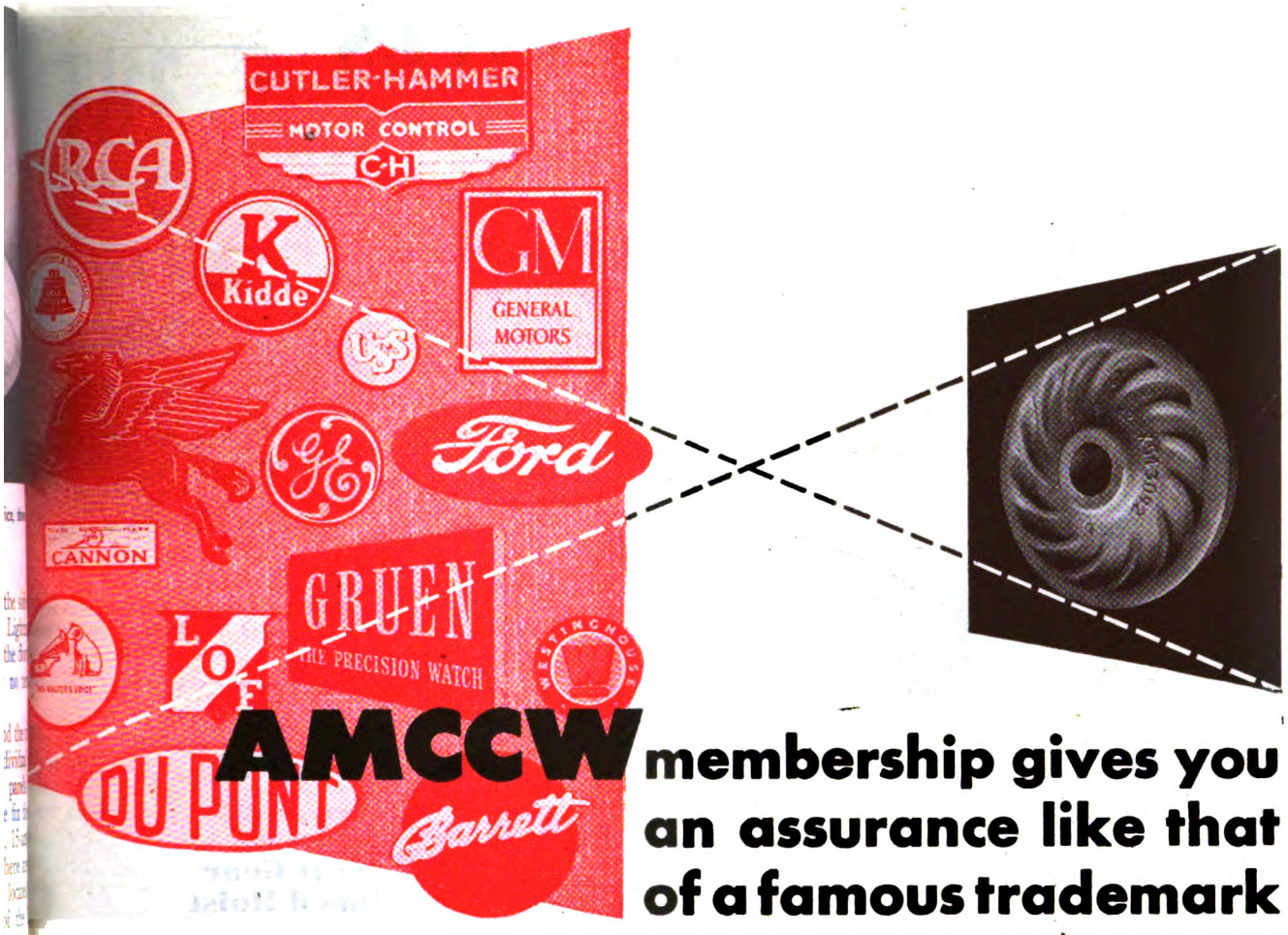

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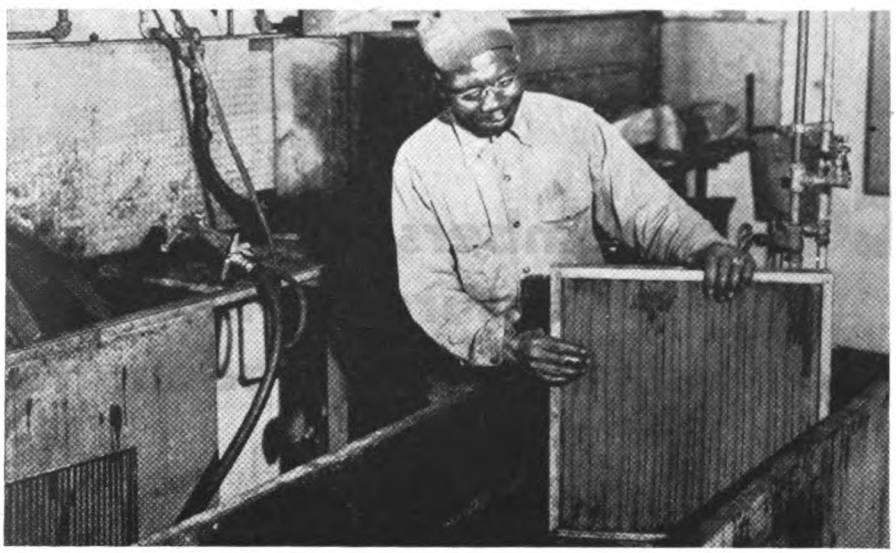
NEW DEVICES

Air Filter Cleaner

A process for the chemical cleaning of all types of air filters, including air conditioning and engine filters has been developed in the laboratories of Turco Products, Inc., of 6135 South Central Avenue, Los Angeles 1, Calif. The process eliminates the necessity of using distillate or other materials which may leave an offensive odor or are a fire hazard. It also shortens the time required for the complete operation. The procedure is to immerse a filter for six minutes in a tank of cold Turco Aktiv, mixed in the proportion of four ounces to a gallon of water. The filter is removed from the dipping tank and given a cold water hosing to flush away dirt and grease; then dried in a stream of compressed air, and dipped into the manufacturer's specified oil. According to time-studies the entire process takes under thirteen minutes. Required equipment is simple and no skilled labor is necessary.



Air filter being removed from cleaning tank

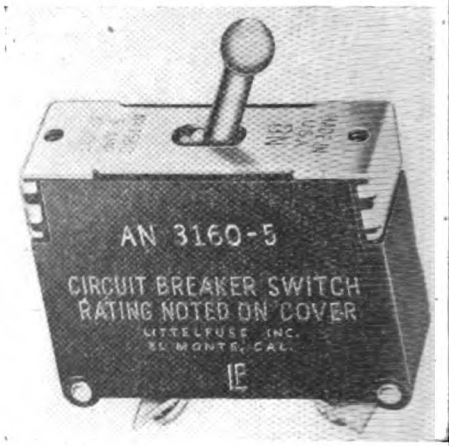
Motor Attachments For Duff-Norton Jacks

Manually operated jacks can be converted for motor operation by means of Duff-Norton motor attachments, according to the Duff-Norton Manufacturing Company, Pittsburgh 30, Pa. The attachments are made in two types, Duff and Norton. Both types are quickly and easily attached, making possible the use of portable shop motors of 1½-in. to 2-in. drill size to power jacks for lifting, lowering, pushing or pulling. The No. 4085 Duff attachment is designed for use with Duff-Norton governor-controlled jacks, and may be attached or removed as desired. The No. 4086 is a permanent model, and is bolted to the jack.

The Norton motor attachment, No. 571-MA, is used with Duff-Norton self-lowering speed-controlled jacks, and is quickly slipped on the jack pinion shaft after removal of the ratchet case and gear.

Switch Breaker

A circuit breaker relatively free from the effects of extreme high and low temperatures is announced by Littelfuse Inc., Chicago. The actual trip temperature of the breaker without flow of current is 350 deg. F., ambient temperature. The bi-metal which responds to temperature is used as the finger that pulls the trigger. No appreciable mechanical load is exerted on the bi-metal as it trips the breaker. Its high time lag adapts it to protection of motors and other equipment having high starting surge currents. The capacity range is 5 to 50 amp. at 32 volts a. c. or d. c. It is capable of breaking 2,500 amp. on short circuit. It meets the requirements of holding for one hour at 115 per cent of rated current; breaks within the hour on 13[illegible] per cent of rated current; breaks at 20[illegible] per cent of its load between 10 and 10[illegible] seconds. These tests are all at the ambient temperature of 77 deg. F. + 1.8 deg. F[illegible]

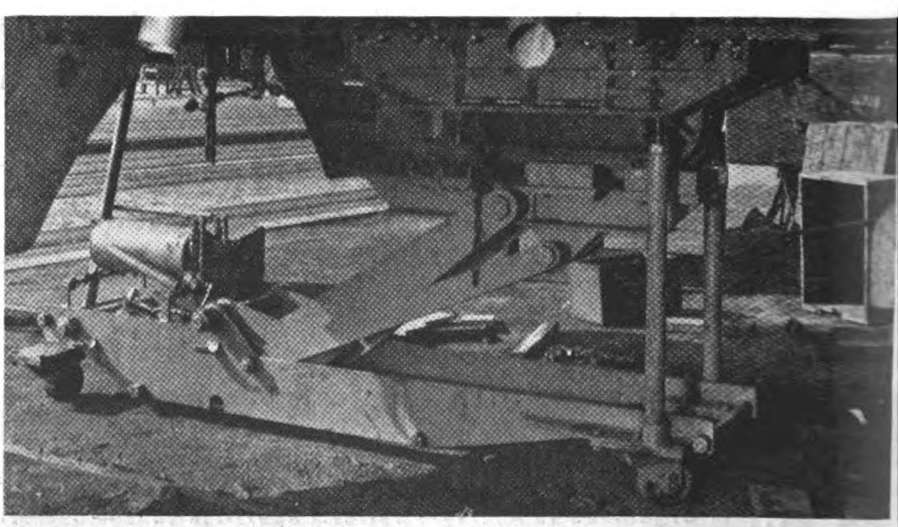


The breaker is affected little by high ambient temperatures and is suitable for motors requiring high starting surge currents

Draft Gear Speed Hoist

The Malabar Machine Company, Los Angeles, Calif., is manufacturing a fast-acting, hydraulically operated hoist to expedite the removal and installation of draft gears, drawbars and yokes in passenger and freight cars. It is also designed to pull "frozen" draft gears down from the carrier by looping a chain around the draft gear and the table of the hoist. For this purpose it exerts a pull of three tons. It has a lifting capacity of five tons.

On the hoist table, which is constantly in a horizontal position, there are movable fingers which can be adapted to hold the draft gear, drawbar and yoke The unit is mounted on ball-bearing swivel casters for portability and easy spotting under cars.



Hydraulic hoist for applying and removing draft gears

(Turn to next left-hand page)

THE VIRGINIAN RAILWAY

places in service a fleet of . . .

8 LIMA-BUILT 2-6-6-6s

To handle its heavy coal traffic still more efficiently, The Virginian Railway has just put into operation eight four-cylinder, six-coupled articulated steam locomotives. These Lima-built giants are capable of hauling the heaviest freights, over mountain grades, at sustained high speeds.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

NEWS

"Reconversion Chairmen" for Equipment Industry

THE War Production Board has announced the selection of "reconversion chairmen" for some 400 industries as a step in its program to facilitate, as far as the requirements of the armed services permit, the change over of industry from military to civilian production during the period—termed by the W. P. B. "Period One"—between the victory in Europe and the victory over Japan.

In the Transportation division, the "reconversion officer" for which is James M. Hennigan, six reconversion chairmen have been named. James D. Driscoll has jurisdiction over the railroad car and specialties field; M. K. Tate over locomotives and locomotive control equipment; Richard Caswell over street cars, buses, and equipment; F. L. Galbraith over brake actuating mechanisms, repair parts and miscellaneous products under the Transportation Equipment division; Sally T. Challis over track equipment and maintenance of way work equipment; and E. M. Moore over signal equipment.

The chairmen, according to the W. P. B. statement, will "advise and consult" with their various industries on problems affecting machine tools, equipment, construction and materials for reconversion, and "should be consulted on all reconversion problems."

Third Quarter Allocations

INDICATIONS of "some future improvement in the transportation equipment situation" are seen by the Office of Defense Transportation as a result of the War Production Board's recent allotment to it of increased quantities of controlled materials for this year's third quarter. Among other things, the O. D. T. statement called attention to the fact that construction of new passenger cars is now authorized for the first time since 1942 although they will not be in production until early in 1946.

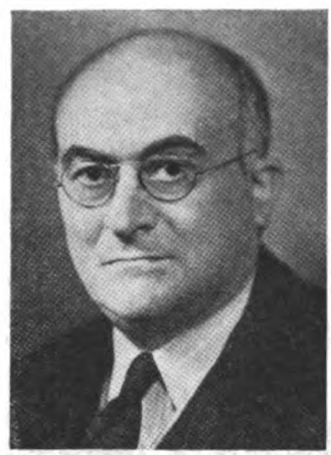
The allocation for passenger-train cars is 5,000 tons of carbon steel and 5,500 tons of alloy steel. According to O. D. T., this will produce "250 coaches, head-end cars and non-luxury type diners, and starts a program of 250 passenger cars quarterly beginning the first quarter of 1946." The program, the statement adds, "is the result of pressure from the O. D. T. for equipment to carry next winter's heavy passenger load caused by the Army's announced 'redeployment' program."

Total third-quarter allocations of carbon steel for transportation are 1,339,588 short tons, the largest 1945 quarterly allocation thus far. It amounts to 87 per cent of the 1,532,136 tons requested by O. D. T. as compared with a second-quarter allotment amounting to only 70 per cent of the amount requested. The total alloy-steel allocation is 128,840 tons as compared with the second quarter's 98,000 tons. "The necessary amounts of copper and aluminum were allotted to accord with the steel allotments," O. D. T. said.

The rail allocation for steam railroads amounts to 495,900 tons, as compared with 417,000 tons in the second quarter. The allotment for track accessories is 244,500 tons. For locomotives, the 41,500 tons requested were allocated. This compares with a second-quarter allocation of 30,000 tons. The previously-reported freight-car allotment of 220,000 tons is 7,000 tons less than the amount requested; but it is expected to cover present schedules of about 11,000 cars to be built in the fourth quarter.

Spraragen Becomes Welding Research Council Director

W. SPRARAGEN, executive secretary, has been appointed to the newly created position of director of the Welding Research Council of the Engineering Foundation. Mr. Spraragen has served as executive secretary of the Welding Research Council since its organization in 1935. He was appointed research assistant to the welding research committee of the National Council of Defense and the Emergency Fleet Corporation in 1918. He was secretary of the division of engineering, National Research Council from 1920 to 1934 and secretary of the American Bureau of Welding from 1921 to 1936. He served as technical secretary of the American Welding Society from 1927 to 1942 and is editor and business manager of the Welding Journal, official publication of the society. Mr. Spraragen was editor of the first two editions of the Welding Handbook published by the American Welding Society and is the author or co-author of many reviews of literature on practcially all phases of welding.



W. Spraragen

I. C. C. Orders Power Brakes on All Freight Cars

THE Interstate Commerce Commission, in an order by Division 3 in the No. 13528 proceeding and an accompanying report on further hearing by Commissioner Patterson, has formally prescribed specifications and requirements for power brakes and appliances for operating power-brake systems for freight service, and has directed the installation of such equipment on all cars used in freight service, except cars equipped with passenger-car brakes, before a date to be set later. The report indicated that, "at least until something better is developed, the AB brake should be considered as in reasonable and substantial conformity with the proposed specifications and requirements, and with the law."

Finding that the record does not afford sufficient information for fixing precise requirements as to the rate at which suitable equipment must be installed or the dates when such installations must be completed, the commission has directed each railroad to file with it, on or before August 28, a statement of its best estimate of the time when it can complete installation of brakes and appliances in conformity with the prescribed specifications on its interchange and non-interchange cars.

Pointing out that the commission has no control over owners of private cars, except that it may require the railroads not to move cars not equipped with approved brakes, the report added that "we are of the view that the installation of AB brakes on private freight cars used in interchange service should proceed coincidentally with whatever program is prescribed for the installation of such brakes on railroad-owned cars."

The proposal of the carriers represented by the Association of American Railroads that cabooses and cars not normally interchanged with other roads should be exempted from the requirements with respect to power brakes, and that the commission's order should apply "in the first instance" only to revenue cars in interchange service, was noted in the report with the following comment:

"Since the Safety Appliance Acts are designed to promote safety in railroad operation, and since good brakes are of primary importance as a safety measure, we are of the view that eventually every car used, whether in interchange service or not, should be equipped with the best available brakes. We shall not, therefore, permanently exempt any equipment subject to the present inquiry from the requirement for installation of AB brakes, with one exception." (This exception, namely, cars equipped with passenger car brakes, also has been proposed by the carriers.)

1944 Association Proceedings

THE 1944 annual proceedings of The Railway Fuel and Traveling Engineers' Association are available through the secretary, T. Duff Smith, 327 South La Salle street, Chicago 4. The price is $3 per copy.

The Car Department Officers' Association proceedings for 1944 are available through the secretary-treasurer, F. H. Stremmel, 59 East Van Buren street, Chicago, at $3 per copy.

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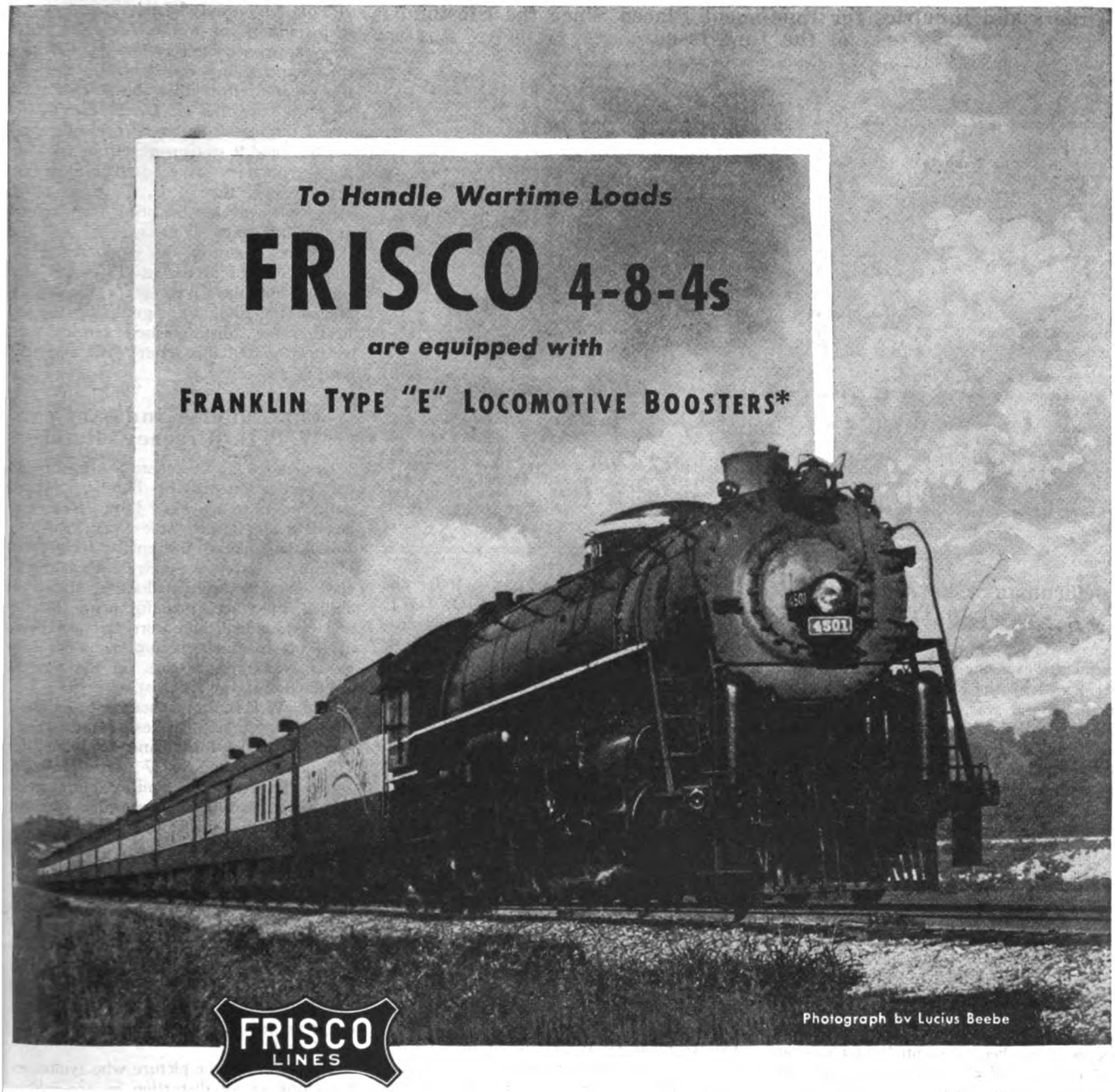

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Orders and Inquiries for Equipment Placed Since the Closing of the June Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Boston & Maine	10[1]	4,000-hp. Diesel-elec.	Electro-Motive
Denver & Rio Grande Western	3	5,400-hp. Diesel-elec. frt.	Electro-Motive
Southern	6	5,400-hp. Diesel-elec. frt.	Electro-Motive
	14	1,000-hp. Diesel-elec. sw.	Electro-Motive
Union Pacific, Chicago & North Western, Southern Pacific	1	6,000-hp. Diesel-elec. pass.	Electro-Motive
Union Pacific	1	6,000-hp. Diesel-elec.	Electro-Motive
Chicago & North Western	1	4,000-hp. Diesel-elec.	Electro-Motive
Union Pacific	1	4,000-hp. Diesel-elec.	Electro-Motive
	3	2,000-hp. Diesel-elec. units	Electro-Motive
	15	Diesel switchers	Electro-Motive
	10	Diesel switchers	American Loco. Co.
	1	Diesel switcher	Fairbanks-Morse

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Atlantic Coast Line	39[2]	Stainless Steel	Edw. G. Budd
Florida East Coast	20[3]	Stainless Steel	Edw. G. Budd

[1] Two for the Maine Central.

[2] For A. C. L. and connections (Penn. and R. F. & P.) in joint through route from New York to Miami.

[3] Six for through New York-Miami service and 14 for local operations between Jacksonville, Fla., and Miami.

NOTE: The Defense Plant Corporation, at the request of the Office of Defense Transportation, has authorized the acquisition of additional troop sleepers and kitchen cars at a cost of about $20,000,000. This equipment will be used in moving troops in this country during the shift of the armed forces from the European theater to the Pacific. It will be operated by the Pullman Company for the government agency, which will retain title. It is understood that 1,200 troop sleepers and 400 kitchen cars will be built under this authorization.

Truman Asks Americans Not to Travel

APPRAISING the transportation job ahead as "even bigger" than the "miracle" performed by the carriers during the first phase of the war, President Truman on June 7 called upon the public to "lend co-operation in order that the burden may be minimized." In response to questions he said that he was prepared to establish travel rationing if it becomes necessary, although he **hopes it will not.**

With the statement, the White House also made public the text of a letter the President had written to the O. D. T. director. The letter stated that the transportation facilities of the nation "are now called upon for the most gigantic task in all the history of transportation." It went on to point up the job already done, adding that contemplation of the remaining task "would overtax our faith if we had not found during the course of this war that the impossible had become our daily job."

In closing the President asked Colonel Johnson to "extend my congratulations to all of our transportation agencies—and their millions of workers—on the results they have accomplished. At the same time express my confidence in them for the greater effort that lies ahead." For his own part, the O. D. T. director followed through from the President's appeal with a June 9 statement setting up a six-point voluntary travel curtailment program which, the O. D. T. press release said, "may avert the need for rationing at this late stage of the war."

Colonel Johnson has endorsed a facsimile copy of President Truman's letter commending the carriers, for the *Railway Mechanical Engineer,* signalizing the publication for "distinguished service"; and has transmitted this letter with a personal note to the editor.

Car Building Industry on W. P. B. "Urgency" Rating

IN a move "to overcome a lag in freight car production that is handicapping the nation's railroads as they face their heaviest war burden," the War Production Board has placed the entire freight car-building industry, the entire railroad brake-shoe manufacturing industry, the entire chilled car-wheel manufacturing industry and certain malleable-iron and steel foundries manufacturing components for locomotives and freight cars on the National Production Urgency List.

The W.P.B. announcement explained that the action provides plant urgency ratings "of the third band or better" for 112 plants located in 17 states, and will "open the way for similar elevation in man-power ratings." Generally speaking, it added, only "direct military producers" have higher ratings.

Supply Trade Notes

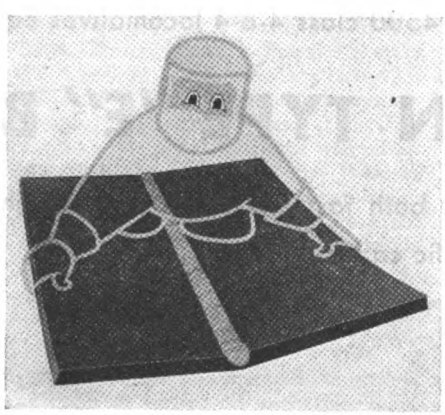
CANADIAN LOCOMOTIVE COMPANY.—*Ralph Schmidt,* assistant chief mechanical engineer, has been appointed chief mechanical engineer of the Canadian Locomotive Company to succeed *G. Cavin,* who has retired after 33 years' service with the company.

◆

CRANE COMPANY.—The Crane Company has announced the following changes in its sales and branch house division: *Carter T. Pollock,* formerly manager of Crane's Chicago branch, has been appointed manager of the central district with headquarters in Chicago; and *W. A. Burbine,* manager of the Cleveland, Ohio, branch, has been appointed manager of the Chicago branch. *A. N. Rosborough,* manager of the Toledo, Ohio, branch, succeeds Mr. Burbine at Cleveland; *W. D. LaRue,* manager of the Muncie, Ind., branch, succeeds Mr. Rosborough at Toledo, and *R. C. Danielson,* manager of the plumbing department at the Indianapolis branch, succeeds Mr. LaRue at Muncie.

◆

LINCOLN ELECTRIC COMPANY.—Fundamentals of welding procedure, particularly those which have to do with the prevention and control of shrinkage are effectively explained in a 16-mm. sound-color motion picture made by Walt Disney Productions for the Lincoln Electric Company, Cleveland, Ohio. To permit an easy understanding of the real cause of distortion, the effect of heat on an ordinary steel bar is portrayed showing just what causes the bar to expand, contract and warp out of shape. The movie then points out how distortion can generally be prevented in any product or structure by the application of three simple rules.



The villain of the picture who symbolizes the cause of all distortion in arc-welding is "Mr. Shrink." This animated character causes a great deal of trouble but is thwarted at every turn and is even unknowingly put to work to overcome distortion in several cases.

The film shows how to reduce the effective shrinking force of a weld, how to make shrinking forces work to minimize distortion, and how to balance shrinkage forces with other forces. The film bears the title "Prevention and Control of Distortion in Arc-Welding." It has a running time of 20 minutes and is available on request at no charge except for transportation.

Mr. Shrink is a character who has been conceived to illustrate the effect of shrinkage forces in arc-welding.

◆

MCCONWAY & TORLEY CORPORATION.—*Rudolph Leppla,* formerly mechanical engineer for the Bettendorf Company, has been appointed chief engineer of the McConway & Torley Corp., of Pittsburgh, Pa.

(*Turn to next left-hand page*)

Safety

CAN NEVER BE FULLY AUTOMATIC!

The engineman must always be on the alert to make certain that water glasses and gauge cocks show adequate water in the boiler. This is a routine operating responsibility of the locomotive crew.

But if, under any conditions, the water becomes low, the locomotive equipped with Security Circulators has an added protection.

Security Circulators insure a positive flow of water over the center of the crown sheet at all times, besides strengthening the firebox structure.

AMERICAN ARCH COMPANY, INC.

NEW YORK · CHICAGO

SECURITY CIRCULATOR DIVISION

PITTSBURGH STEEL COMPANY.—*Lt. Col. John Kennedy Beeson,* who recently completed his duties with the United States Strategic Air Forces in Europe, has been elected executive vice-president of the

Lt. Col. John K. Beeson

Pittsburgh Steel Company. Col. Beeson is the son of the late Charles E. Beeson, one of the original founders of the Pittsburgh Steel Company. He was vice-president in charge of sales for the company when he enlisted in the Air Corps in May, 1942. Previously he was assistant general superintendent of the company's plant operations at Monessen and Allenport, Pa. He is a graduate of Yale University.

◆

INTERNATIONAL NICKEL COMPANY; DOW CHEMICAL COMPANY; CARNEGIE-ILLINOIS STEEL CORPORATION.—On June 5-6, 18 engineers and editors of technical publications were shown corrosion tests at the Corrosion Testing Station, Kure Beach, N. C. The visitors were guests of the International Nickel Company, Inc., the Dow Chemical Company, the Ethyl-Dow Chemical Company, and the Carnegie-Illinois Steel Corporation, joint sponsors of this testing station, at which products of more than 200 companies have been exposed to atmospheric or sea-water corrosion.

At this point, on the shore of the Atlantic Ocean, tests of various metals, alloys and coatings have been conducted for periods varying from 5 to 10 years. These tests include samples exposed to sea air and samples completely submerged in sea water, traveling at low and high velocities. At the present time, approximately 15,000 specimens are being exposed to atmospheric corrosion, while about 2,000 specimens comprise the submerged tests. In the past 10 years, a total of about 4,000 specimens have been given submersion tests. In addition, during the past two years, various specimens of treated wood have been submerged in sea water to determine the resistance of different types of treatment to marine borers. A total of about 5,000 specimens of treated wood have been tested to date.

◆

SNAP-ON TOOLS CORPORATION.—The Snap-on Tools Corporation, Kenosha, Wis., recently celebrated its twenty-fourth anniversary.

PITTSBURGH STEEL FOUNDRY CORPORATION.—The Pittsburgh Steel Foundry Corporation, Glassport, Pa., has acquired a controlling interest in the Pittsburgh Spring & Steel Co., which will be operated under its present corporate name as a division of the Pittsburgh Steel Foundry. The following officers have been elected for the Pittsburgh Spring division: *G. D. Thompson,* president; *E. S. Weidle,* vice-president; *M. A. Colville,* treasurer; *Winthrop B. Braun,* secretary; and *David W. Kettering,* assistant secretary-treasurer.

◆

OXWELD RAILROAD SERVICE COMPANY.—*Frank C. Hasse* has been elected vice-president—mechanical department of the Oxweld Railroad Service Company, a unit of the Union Carbide & Carbon Corp. Mr. Hasse began his railroad career in 1904 with the Atchison, Topeka & Santa Fe. Thereafter he was successively a fire-

Frank C. Hasse

man on the Chicago, Burlington & Quincy and engine foreman and general boiler foreman on the Illinois Central System. He started as an instructor with the Oxweld Railroad Service Company in 1913, and was assigned to the Chicago main office in 1916. Mr. Hasse entered the Army as a captain in the first World War. He was appointed superintendent of construction at Camp Normyle, San Antonio, Texas, and subsequently was commanding officer of that camp. After rejoining the Oxweld Company in 1919, he was appointed superintendent of construction and maintenance, and, in 1927, general manager.

Army-Navy "E" Awards

American Steel & Wire Co., Cuyahoga, N. Y. May 22.

Babcock & Wilcox Co., Barberton, Ohio. Fifth renewal.

Broderick & Bascom Rope Co., St. Louis, Mo. Sixth citation.

Dayton Rubber Manufacturing Company, Waynesville, N. C.

Maxim Silencer Company, Hartford, Conn. Fourth star.

Monroe Auto Equipment Company, Monroe, Mich. Fifth award.

National Battery Company, Gould industrial division, Depew, N. Y. Third star.

◆

BALDWIN LOCOMOTIVE WORKS.—*W. F. Boyle* has been appointed assistant to the vice-president to direct the Pacific Coast district office of the Baldwin Locomotive Works and the Pelton Water Wheel Company, wholly owned subsidiary. Mr. Boyle will temporarily assume the duties at the San Francisco, Calif., headquarters formerly performed by *F. R. Kohnstamm,* who has been relieved due to illness. *C. G. Crawford* will continue as acting general manager of Pelton and in addition will be responsible for all industrial sales and service in the Pacific Coast district. *C. D. Allen* continues in charge of railroad sales and service at San Francisco. Mr. Boyle served in various executive engineering capacities with the Westinghouse Electric & Manufacturing Co. following his graduation from the Pratt Institute in 1927. Most recently he was sales manager of the aviation turbine division of Westinghouse.

Frank K. Metzger, vice-president in charge of sales of the Baldwin Locomotive Works, has resigned effective June 30.

◆

AIREON MANUFACTURING CORPORATION.—*Ralph R. Gunderson* has been appointed sales manager of the brake division of the Aireon Manufacturing Corporation with headquarters in Chicago.

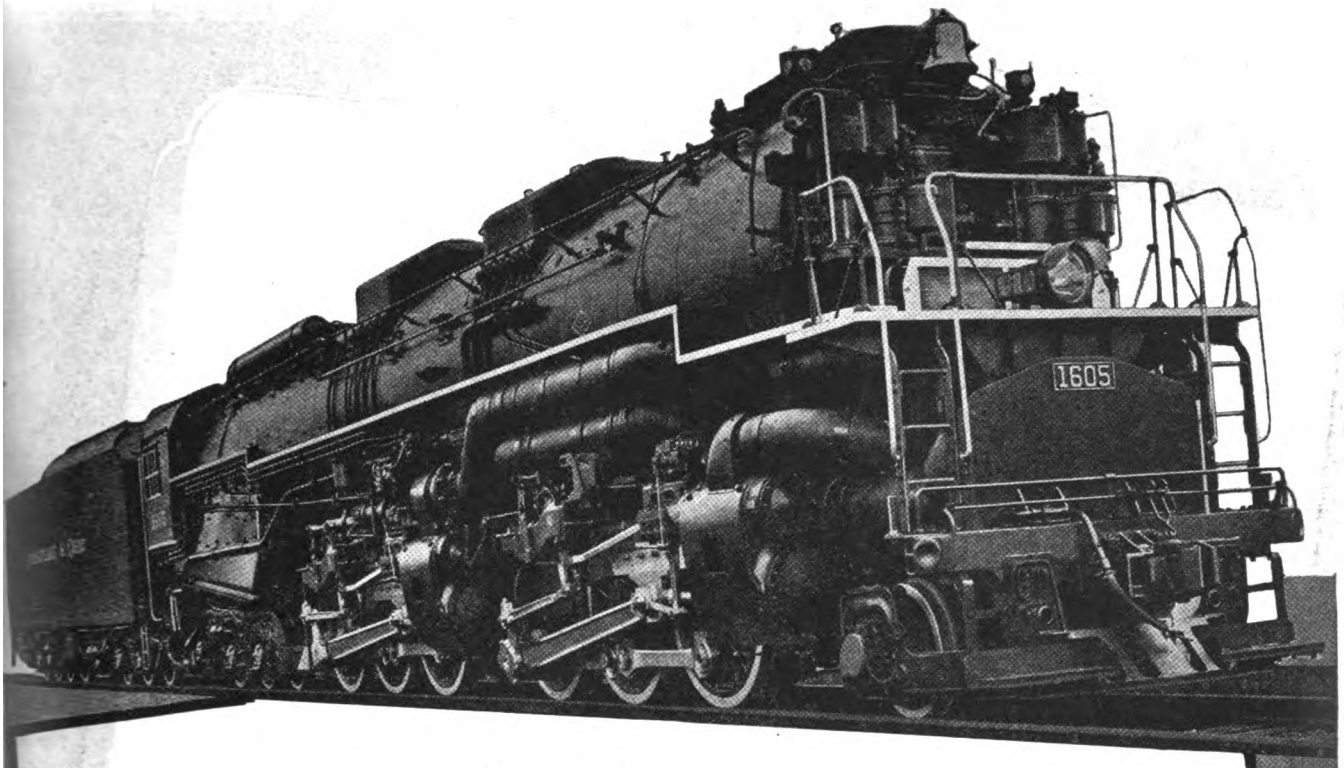
◆

AMERICAN CAR AND FOUNDRY COMPANY.—*Victor R. Willoughby,* vice-president of the American Car and Foundry Company, formerly in charge of engineering and since December, 1943, director of research and development, has retired after almost fifty years of association with the company. Mr.

Victor R. Willoughby

Willoughby is a graduate of Michigan University where he received a degree in mechanical engineering in 1896. He began his career with the Michigan Peninsular Car Company. When that company was taken over by the American Car and Foundry Company at the time of its incorporation in 1899, he was appointed assistant mechanical engineer. He served as engineer at various plants of the company and later in New York, where he subsequently became general mechanical engineer. He was elected vice-president in charge of engineering in February, 1938. During the war, Mr. Willoughby served as assistant chairman and chief civilian officer of the integration committee on the light tank.

(*Turn to second left-hand page*)



It *Pays* to Specify *Higher* Superheat

Higher superheat means higher cylinder efficiency with increased cylinder horsepower. Maximum superheating surface also means more free steam area.

A design for higher superheat should be specified for all new locomotives . . . and can be used to advantage when old power is modernized.

A-1691

SUPERHEATERS • FEEDWATER HEATERS
AMERICAN THROTTLES • STEAM DRYERS
EXHAUST STEAM INJECTORS • PYROMETERS

THE SUPERHEATER COMPANY

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IT'S A GREAT NEW DAY FOR RAILROADING

A POSTWAR PROPHECY

GENERAL MOTORS
LOCOMOTIVES

IT'S A GREAT NEW DAY FOR RAILROADING

After the war, industries

will favor railroads

able to deliver

faster, on-time,

dependable freight service.

That is one reason that

General Motors Diesel

freight locomotives are

a "must" on many lists.

ON TO FINAL VICTORY ★ BUY MORE WAR BONDS

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS CORPORATION · LA GRANGE, ILL.

GENERAL STEEL CASTINGS CORPORATION.—*E. G. Hallquist,* special representative in the Chicago district sales office of the General Steel Castings Corporation, has been transferred to the company's Granite City, Ill., plant as assistant vice-president.

◆

COPPERWELD STEEL COMPANY.—*Fred Brown,* New England sales engineer for the Copperweld Steel Company, has been transferred to the home office at Glassport, Pa., as staff engineer in the general sales department. *H. M. MacDougal,* who has been in the sales engineering department at Glassport, succeeds Mr. Brown in the New England territory.

◆

TIMKEN ROLLER BEARING COMPANY.—*O. J. Horger,* formerly in charge of railway engineering and research, has been appointed chief engineer of the railway division of the Timken Roller Bearing Company. *C. L. Eastburg,* who is in active charge of the design of bearings and parts as applied to locomotives, has been appointed assistant chief engineer of the railway division and *P. C. Paterson,* who has been active in the inspection and procurement of material and in equipment applications, has been appointed service manager of the railway division.

O. J. Horger

P. C. Paterson

O. J. Horger is a graduate of the Carnegie Institute of Technology, with a Bachelor of Science degree, and of Michigan University with a Doctor of Science Degree. While at Michigan University he instituted and was in charge of the fatigue testing of locomotive and car axles, a part of a program of general research. He joined the Timken Company in 1924. He is the author of many technical articles and is a member of the American Society of Mechanical Engineering, the American Society for Metals, the American Society for Testing Materials, the Society for Experimental and Stress Analysis and the British Locomotive Institute.

C. L. Eastburg

C. L. Eastburg attended Illinois University and joined the Timken Company in 1927. *P. C. Peterson* attended the Carnegie Institute of Technology. He is a member of the American Society for Metals.

◆

CLARK EQUIPMENT COMPANY.—*George Spatta,* executive vice-president, has been elected president of the Clark Equipment Company, Buchanan, Mich., to succeed the late Albert S. Bonner. *John G. Mack* has been elected a vice-president and director of the company. Mr. Spatta was formerly in the employ of the General Electric Company. He joined the Clark organization in 1927, serving successively as development engineer, chief engineer, general manager, and executive vice-president.

◆

WESTINGHOUSE AIR BRAKE COMPANY; UNION SWITCH & SIGNAL COMPANY.—*Albert N. Williams,* president of the Western Union Telegraph Company, has been elected a director of the Westinghouse Air Brake Company and of the Union Switch & Signal Co.

◆

ELECTRO-MOTIVE DIVISION, GENERAL MOTORS CORPORATION.—*Nelson C. Dezendorf* has been appointed a director of sales of the Electro-Motive Division of the General Motors Corp. with headquarters at La-Grance, Ill. This is a new position. *O. F. Brookmeyer* will continue in the position of sales manager, until his impending retirement under a General Motors pension plan.

Nelson C. Dezendorf was born at Portland, Ore., on April 23, 1898. He received his higher education at the University of Oregon and the University of California. He served in the armed forces during World War I and in 1920 entered the employ of the European Pacific Steamship Co., where he was engaged in making surveys of West Coast and European port activities. In 1922 Mr. Dezendorf went with the General Motors Acceptance Corp., at Portland, and five years later was appointed manager of the Seattle, Wash., office of that organization. Some time later he was transferred to the business development department at New York, becoming manager of that department in 1929. In 1931 he was elected a vice-president of G. M. A. C., and in the following year was given a special assignment in the sales section of General Motors at Detroit, Mich. On January 1, 1941, Mr. Dezendorf became a director and a member of the executive committee of G. M. A. C. He relinquished these positions later in 1941 to become general assistant to the vice-president in charge of distribution of General Motors. When R. H. Grant, the then vice-president in charge of disttribution, retired in January, 1944, Mr. Dezendorf became director of the distribution staff.

Nelson C. Dezendorf

◆

UNION ASBESTOS & RUBBER CO.—*John S. Lundvall* has been appointed manager of the equipment specialties division in charge of sales and engineering of the Union Asbestos & Rubber Co. to succeed *George A. Hull,* who has been transferred to Los Angeles, Calif. Mr. Lundvall joined the company in 1925 as a mechanical engineer.

John S. Lundvall

AMERICAN LOCOMOTIVE COMPANY.—The American Locomotive Company and Union College have entered into a contract under which the American Locomotive Company will enlarge the physics laboratories of the college in exchange for the use of certain laboratory and other facilities and for help on specific technical problems by members of the Union College science faculty. The company has agreed to provide the college with ten or twelve new physics laboratories and to supervise their building under the present physics building on the campus. Construction is to be completed within a year. The college for a period of five years after completion of the laboratories is to designate one of the laboratories for use by the company and is to equip and maintain it. In addition the college is to make available to the company during the five-year period faculty and research personnel for work with the company in its laboratory and for at least four meetings a year during which the college and company representatives will make shop inspection trips and discuss any company problems submitted to them.

◆

BETTENDORF COMPANY.—*Herman Mangelsdorf,* until recently in the mechanical engineering department of the Chicago, Rock Island & Pacific at Silvis, Ill., has been appointed to the engineering staff of the Railway division of the Bettendorf Company, where he will be assigned to railway specialty designing. Mr. Mangelsdorf has been employed since 1922 chiefly in the engineering departments of the Union Pacific at Omaha, Neb., and of the Rock Island at Silvis, where he had to do with car and locomotive design.

◆

ELECTRIC SERVICE MANUFACTURING COMPANY.—*A. H. Englund,* president and treasurer of the Electric Service Manufacturing Company, Philadelphia, Pa., has been elected chairman of the board and treasurer. *H. G. Lewis,* vice-president and general manager, has been elected president and general manager. *Russell Kreinberg* has been appointed vice-president and assistant general manager, and *I. W. Schmidt,* western manager, has been appointed a vice-president with headquarters as heretofore in Chicago.

◆

OLIVER IRON & STEEL CORPORATION.—*Edward M. Welty,* assistant general manager of sales, has been appointed general manager of sales of the industrial fasteners division of the Oliver Iron & Steel Corporation to succeed *James G. Graham.*

◆

NATIONAL BATTERY COMPANY.—*Richard H. Rowland,* vice-president in charge of the National Battery Company's Gould industrial division, Depew, N. Y., has been appointed to the added responsibility of general sales manager to succeed *John C. Sykora,* vice-president in charge of sales, who has resigned. Mr. Rowland is a graduate of Michigan University. He was vice-president of the St. Paul Engineering & Manufacturing Company prior to his recent connection with National Battery.

Obituary

W. T. BRASSIL, vice-president and general manager of the Adams & Westlake Co., with headquarters at Elkhart, Ind., died in a Chicago hospital on June 3.

◆

BYERS W. KADEL, consulting engineer for the Symington-Gould Corporation since 1920 with headquarters in Baltimore, Md., died May 28. Mr. Kadel was employed as draftsman and car designer for the Norfolk & Western from 1909 to 1918 and served as assistant engineer with the United States Railroad Administration from 1918 to 1920.

◆

LEROY S. WRIGHT, who retired a few years ago from the railway sales department of the National Malleable & Steel Castings Company, died at Winfield, near Chicago, on May 15. Mr. Wright entered the employ of the National Malleable & Steel Castings Company at Sharon, Pa., October 1, 1900, and in 1907 was transferred to the railway sales department at Chicago. Mr. Wright was active over many years in the Railway Supply Manufacturers' Association, which sponsored the exhibits at the Atlantic City, N. J., conventions of the Mechanical and Purchases and Stores Divisions of the Association of American Railroads. He served on various committees of the Supply Association; became a member of the Executive Committee in 1920; was elected vice-president in 1922, and served as president 1924-1926.

Personal Mention

General

J. E. GOODWIN, assistant chief mechanical officer of the Chicago & North Western and the Chicago, St. Paul, Minneapolis and Omaha, has been appointed chief mechanical officer. Mr. Goodwin entered railway service as machinist apprentice in the employ of the Atchison, Topeka & Santa Fe in 1918, and after completion of his apprenticeship, entered college to study engineering at Lake Forest College and the University of Chicago. He re-entered railway service in 1926 as a machinist on the Missouri Pacific at Hoisington, Kan., and a year later was promoted to enginehouse foreman. In 1929 he became erecting foreman of the back shop at North Little Rock, Ark.; in 1932, schedule supervisor, and later production engineer. In 1935, he was appointed general foreman at North Rock shops and in 1939 acting shop superintendent. On January 28, 1941, he was appointed master mechanic of the Palestine and San Antonio divisions of the International-Great Northern, with headquarters at San Antonio, Tex.; on January 1, 1942, mechanical superintendent of the Missouri Pacific Lines with headquarters at St. Louis, Mo., and on October 1, 1943, assistant mechanical officer of the C. & N. W. and the C. St. P. M. & O., with headquarters at Chicago. Mr. Goodwin is president of the Locomotive Maintenance Officers' Association, and a member of the board of directors of the Western Railway Club.

J. E. Goodwin

HORACE M. WARDEN, chief mechanical officer of the Missouri-Kansas-Texas at Dallas, Tex., has been appointed vice-president and general manager, with headquarters at Dallas. Mr. Warden entered railway service in 1914 as a machinist in the employ of the M-K-T. After subsequent promotions he became superintendent of the reclamation plant at Parsons, Kan., in 1916. In January, 1924, he was appointed superintendent of shops at Bellmead, Waco, Tex.; in February, 1924, superintendent of the locomotive department of shops at Parsons; in August, 1925, mechanical superintendent at Parsons, and in October, 1927, chief mechanical officer.

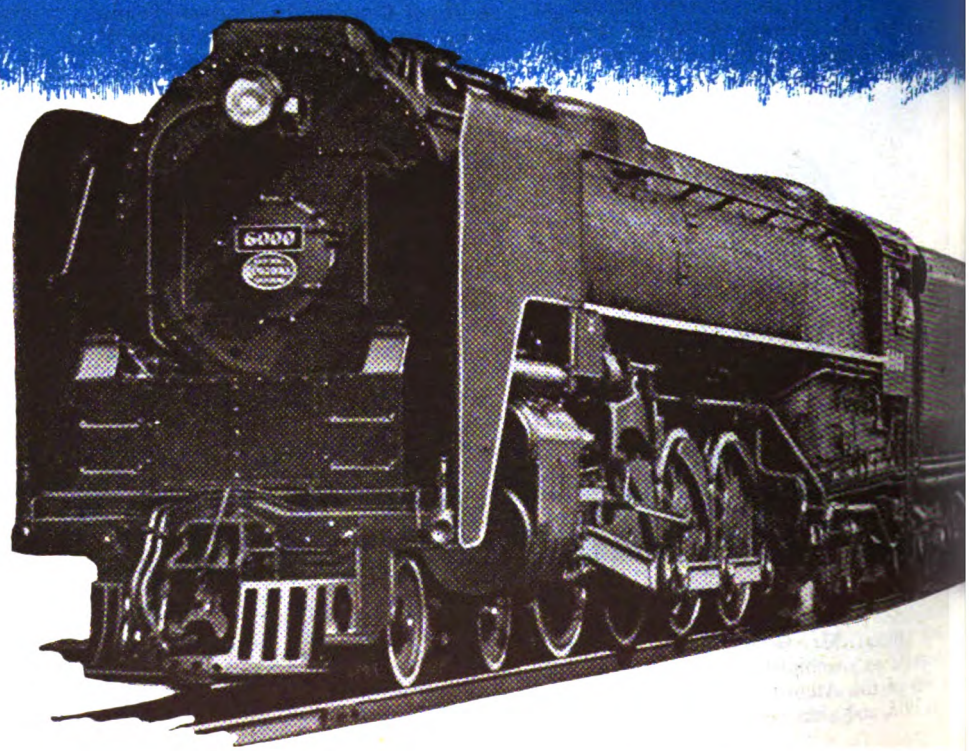
Horace M. Warden

(*Turn to third left-hand page*)

Right for both jobs because it's built for both jobs

THE trains you see on these two pages are being pulled by the New York Central's new dual-purpose locomotive, the "Niagara."

Built by the American Locomotive Company, in close co-operation with the New York Central, it is designed to pull the System's crack passenger liners and also meet the demands for high speeds in hauling freight. Locomotives that possess the *interchangeability* of the "Niagara" promise many benefits. They can help reduce the expense many railroads have had to bear in buying, operating and maintaining powerful locomotives for heavy freight hauls and faster, less powerful locomotives for lighter passenger runs.



They can provide a new kind of operating efficiency
building up extra power needed for tough jobs, and
nserving power on the easier tasks.

And, perhaps most important of all, they can open
ew roads to undreamed-of economies—savings that
ill be shared by thousands.

American Locomotive

Alco

THE MARK OF MODERN LOCOMOTION

Let's get *down to earth*

on train communication

"UNION"
ITC
INDUCTIVE TRAIN COMMUNICATION

Dependable voice communication

"Union" I.T.C. (Inductive Train Communication) system provides dependable, practicable two-way voice communication between vehicles of a train, between trains, and between trains and wayside points.

It is a train communication system designed exclusively for railroad use, by men who know railroad needs, and proved through years of regular railroad service.

Proved in regular railroad service

When you're considering train communication systems, keep this fact in mind—
"Union" I.T.C. is the only system that has been thoroughly proved through years of regular railroad use in yards and in road service.

Here's the record:

Bessemer & Lake Erie R.R. Co.	Road	(Albion, Pa. to Pittsburgh)
Cleveland, Cincinnati, Chicago & St. Louis Ry.	Yard	(Sharonville, Ohio)
Chicago, Burlington & Quincy R.R. Co.	Yard	(Two Yards—Galesburg, Ill.)
Chicago, Burlington & Quincy R.R. Co.	Yard	(Lincoln, Neb.)
Great Northern Ry. Co.	Yard	(Allouez, Wis.)
Louisville & Nashville R.R. Co.	Yard	(DeCoursey, Ky.)
Norfolk & Western Ry. Co.	Yard	(Roanoke, Va.)
The Pennsylvania R.R.	Yard	(Two Yards—Altoona, Pa.)
The Pennsylvania R.R.	Yard	(Columbus, Ohio)
The Pennsylvania R.R.	Yard	(Two Yards—Harrisburg, Pa.)
The Pennsylvania R.R.	Yard	(Indianapolis, Ind.)
The Pennsylvania R.R.	Yard	(Pitcairn, Pa.)
The Pennsylvania R.R.	Yard	(Strip District—Pittsburgh, Pa.)
The Pennsylvania R.R.	Road	(Pittsburgh, Pa. to Harrisburg Under Construction)
The Pennsylvania R.R.	Road	(Trenton, N.J. to Phillipsburg)
Terminal R.R. Association of St. Louis	Yard	(East St. Louis, Ill.)

Proved in regular service—proof that for dependable train communication, *"Union" I.T.C. is the answer.*

Full information will be furnished without obligation by our nearest district office.

UNION SWITCH & SIGNAL COMPANY

SWISSVALE, PA.

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO

T. F. POWERS, whose promotion to assistant to the vice-president of the Chicago & North Western, with headquarters at Chicago, as announced in the June issue, was born at Winona, Minn., on October 2, 1882. He entered railway service on May 1, 1899, as a water boy in the bridge and building department of the North Western at Winona. Two years later he became an apprentice in the locomotive shops at Winona and in 1906 completed his training as a mechanic. In 1907 Mr. Powers became a mechanic in the employ of the Duluth, South Shore & Atlantic at Marquette, Mich., and in July, 1908, returned

T. F. Powers

to the North Western. He was promoted to the position of foreman at Chadron, Neb., one year later. In 1926 he became assistant superintendent of motive power and machinery, Northern district; in December, 1941, superintendent of motive power, Northern district, with headquarters at Chicago, and in 1943 chief mechanical officer.

COLUMBUS R. RUSH, whose promotion to mechanical superintendent of the Missouri Pacific, with headquarters at St. Louis, Mo., was reported in the May issue, was born at Cameron, Tex., on September 17, 1901, and attended the Arkansas State Teachers College. He entered the service of the Missouri Pacific in February, 1923, as a machinist apprentice and four years later became a machinist, serving at various points. In 1930 Mr. Rush was appointed

Columbus R. Rush

enginehouse foreman; in 1941, general enginehouse and shops foreman at St. Louis; in August, 1944, assistant master mechanic, with headquarters at DeQuincy, La., and in January, 1945, master mechanic, at Kingsville, Tex.

C. L. WILSON, superintendent of motive power of the Elgin, Joliet & Eastern, retired on May 14.

J. L. CARVER, mechanical engineer of the Illinois Central at Chicago, has been appointed research engineer, with headquarters at Chicago.

F. P. THEISEN, chief clerk, mechanical department of the Chicago & North Western, with headquarters at Chicago, has been appointed assistant to the chief mechanical officer.

P. O. CHRISTY, general superintendent of equipment of the Illinois Central at Chicago, has been granted a leave of absence because of illness.

F. S. ROBBINS, general superintendent motive power of the Atlantic Coast Line at Wilmington, N. C., has resigned on furlough until the end of this year, when, at the age of 65, he will retire under the provisions of the Railroad Retirement Act.

H. E. MAY, shop engineer of the Illinois Central at Chicago, has been appointed superintendent of equipment, with headquarters at Chicago.

S. O. RENTSCHLER has been appointed superintendent of motive power of the Elgin, Joliet & Eastern, with headquarters at Joliet, Ill.

HAROLD FORSYTH FINNEMORE, whose appointment as chief electrical engineer of the Canadian National was announced in

Harold Forsyth Finnemore

the June issue, was born at Chicago on March 18, 1893, and received his B. S. degree in electrical engineering from Queen's University in 1917. He entered railroading the following year as a draftsman in the employ of the Canadian Government Railways. In September, 1922, he was appointed assistant engineer of the Canadian National; in 1923, assistant electrical engineer, with headquarters at Montreal; in July, 1938, electrical engineer at Montreal, and in December, 1943, assistant chief electrical engineer.

W. R. HARRISON, mechanical superintendent of the Southern district of the Atchison, Topeka & Santa Fe at Amarillo, Tex., is on a leave of absence because of illness.

RAMSEY GRAY GAGE, whose retirement as chief electrical engineer of the Canadian National at Montreal, Que., was announced in the June issue, was born at Kingston,

Ramsay Gray Gage

Ont., on July 14, 1879. He is a graduate of Queen's University at Kingston where he received his B. S. degree in electrical engineering in 1905. He served with the Cataract Power Company at Hamilton, Ont., and the Westinghouse Manufacturing Company at Pittsburgh, Pa., successively until 1907, when he entered the service of the Chicago & Eastern Illinois as supervisor of electric signaling. He served as chief engineer of the General Railway Signaling Company at Lachine, Que., from 1910 to 1914, when he joined the Canadian Government Railways (now the Canadian National) as signal and electrical engineer at Moncton, N. B. In 1922 he was appointed electrical engineer for the system with headquarters at Montreal and in 1926 became chief electrical engineer. In December, 1939, his jurisdiction was extended to include the duties of signal engineer.

FREDERIC WARD BUTT, assistant engineer, office of the equipment electrical engineer, of the New York Central System at New York, has retired after 40 years of service. Mr. Butt, who is 68 years old, entered the

Frederic Ward Butt

ervice of the New York Central in 1905 s assistant engineer, equipment engineering department. He aided in the electrification of the railroad and also designed many locomotives. His work was partly esponsible for the development of electric rains to replace steam trains on the Grand Central Terminal rails from the Terminal o White Plains, N. Y., and Harmon; Mr. Butt also worked on the design, construction, inspecting and testing of the electric multiple unit suburban cars, the first steel assenger cars on the line which were the models for the present commuter trains. Among Mr. Butt's other designs were electric and Diesel-electric locomotives, electric lighting equipment on the trains and lectric lighting and train-stop equipment or locomotives.

G. J. LEHNERER, lead draftsman of the Illinois Central at Paducah, Ky., has been appointed mechanical engineer with headquarters at Chicago.

JAMES B. DIVEN, superintendent of motive power of the Eastern Ohio division of he Pennsylvania at Pittsburgh, Pa., has been appointed assistant to the general superintendent of the Eastern division.

ALONZO G. TRUMBULL, whose appointment as general mechanical engineer of the Chesapeake & Ohio, the New York, Chicago & St. Louis, and the Pere Marquette

Alonzo G. Trumbull

at Cleveland, Ohio, was announced in the June issue, was born at Hornell, N. Y., and received his M. E. degree from Cornell University in 1899. He entered railroading in 1902 as engineer of tests of the Erie and the following year became mechanical engineer. After serving as assistant mechanical superintendent at Meadville, Pa., from 1905 to 1907, he transferred to the Ohio division, being appointed mechanical superintendent shortly thereafter. In 1912 he transferred to the Erie division; in 1914 was appointed assistant to the general mechanical superintendent; in 1919, assistant general mechanical superintendent; in 1920, mechanical superintendent of the Ohio region, and in 1922, chief mechanical engineer of the Erie. In 1929 Mr. Trumbull was appointed chief mechanical engineer of the Advisory Mechanical Committee for the Erie, the Chesapeake & Ohio, the New York, Chicago & St. Louis, and the Pere Marquette, acting in advisory capacity in matters relating to the design of new rolling equipment. In addition to his duties as general mechanical engineer of the Chesapeake & Ohio, Pere Marquette, and New York, Chicago & St. Louis, he will continue as chief mechanical engineer of the Advisory Committee.

LAMAR EARLE CREVASSE, superintendent motive power, of the Macon, Dublin & Savannah at Macon, Ga., has retired. Mr. Crevasse was born at Cedar Keys, Fla., on August 9, 1895, and entered the employ of the Atlantic Coast Line as an apprentice machinist at High Springs, Fla., in February, 1912. He served as machinist at High Springs from August, 1917, to December, 1917, when he became an instructor in the air service of the U. S. Army. He returned to the Atlantic Coast Line as machinist at High Springs in April, 1919. From September, 1919, to July, 1922, he was in the service of the Florida East Coast at Miami, Fla. Mr. Crevasse joined the Seaboard Air Line as machinist at Jacksonville, Fla., in October, 1922; became enginehouse foreman there in January, 1923; general foreman at Tampa, Fla., in October, 1924; master mechanic at Palm Beach, Fla., in February, 1926, and general foreman at Arcadia, Fla., in 1928. He was subsequently transferred to Tampa and Raleigh, N. C., successively, until February 1, 1940, when he was appointed superintendent, motive power, of the Macon, Dublin & Savannah.

A. G. KANN, general master mechanic of the Illinois Central at Waterloo, Iowa, has been appointed general superintendent of equipment, with headquarters at Chicago.

Car Department

OREL C. FARISS, who has been appointed superintendent, car department, of the Virginian at Princeton, W. Va., as noted in the June issue, was born at Goodland, Ind., on April 18, 1896. He entered railroading on March 8, 1916, as an air brake repairman in the employ of the Norfolk & Western at Kimball, W. Va. After serving with the United States armed forces from November, 1917, to 1919, he returned to his old position at Kimball in August, 1919, and was promoted to gang foreman there the following March. In June, 1921, he transferred to Bluefield, W. Va. A year later he became assistant car foreman at Crewe, Va.; car foreman at Lynchburg, Va., in February, 1924; assistant car foreman at Crewe in July 1924, and car foreman at Clare, Ohio, on June 1, 1927. He served as car foreman at Columbus, Ohio, from November 1, 1936, until his appointment as superintendent, car department, at Princeton.

Orel C. Fariss

In Military Service

1st Lt. Raymond Tillack, of Company B, 756th Railway Shop Battalion, has been promoted to the rank of captain, according to a recent issue of "The Yankee Boomer." Captain Tillack, before entering the service, was an enginehouse foreman on the Pennsylvania.

Shop and Enginehouse

J. A. WELSCH, master mechanic of the Illinois Central at Paducah, Ky., has been appointed shop superintendent, with headquarters at Paducah.

R. R. ROYAL, shop superintendent of the Illinois Central at Paducah, Ky., has retired because of ill health.

Obituary

ALBERT JAY CLARKSON, superintendent of electric equipment of the New York Central Lines Buffalo and East, with headquarters at Harmon-on-Hudson, N. Y., died on June 4 at his home at Yonkers, N. Y. Mr. Clarkson, who was born at Bloomington, Ill., on August 4, 1893, received his B. S. degree from the University of Illinois in 1916, and a degree in electrical engineering in 1932. He entered the employ of the New York Central in 1916, serving until 1923 in the electrical engineering department as draftsman, inspector and assistant engineer successively. In 1923 he was appointed general inspector in the electric equipment department, and in 1928 superintendent of electric equipment.

A. T. Clarkson

J. L. CANTWELL, master mechanic of the Southern at Briston, Va., died on June 4.

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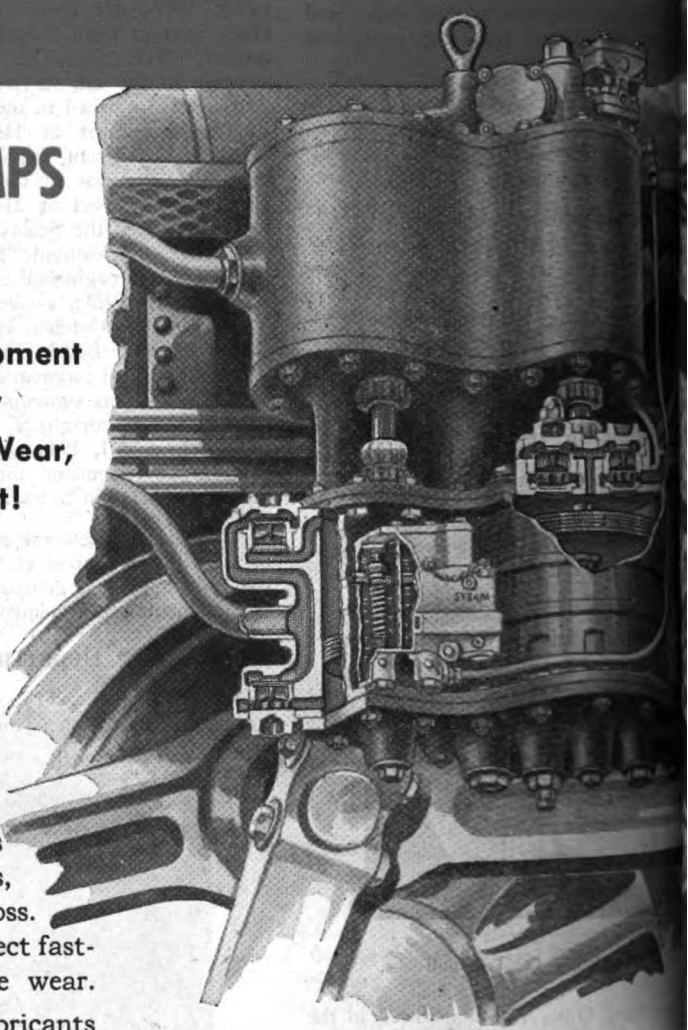

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Railway Mechanical Engineer

August 1945

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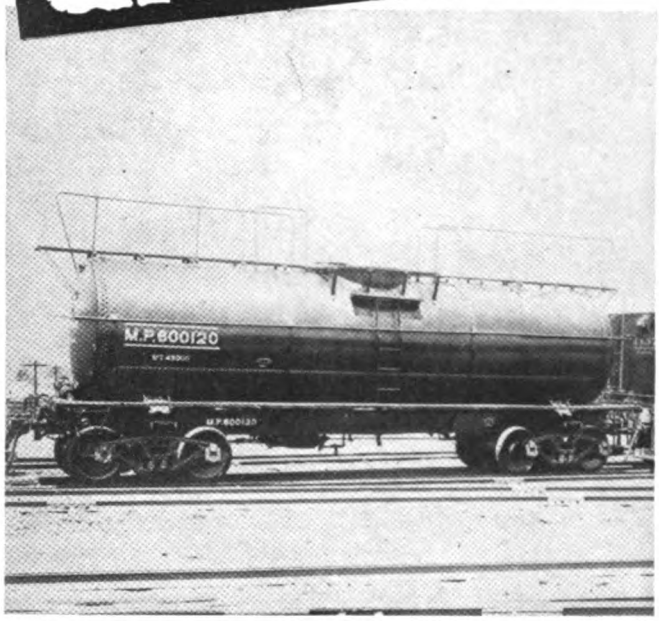

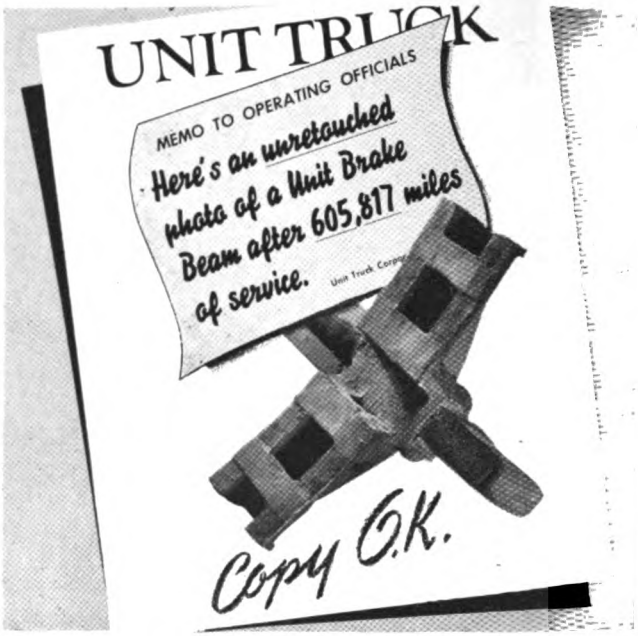

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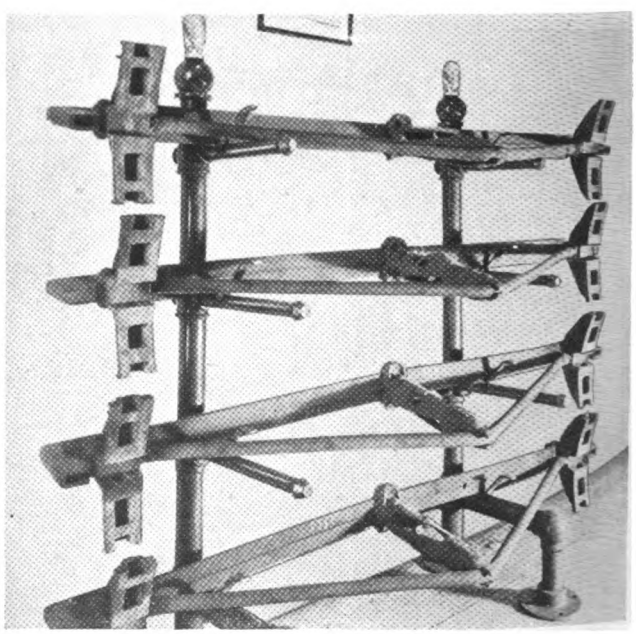

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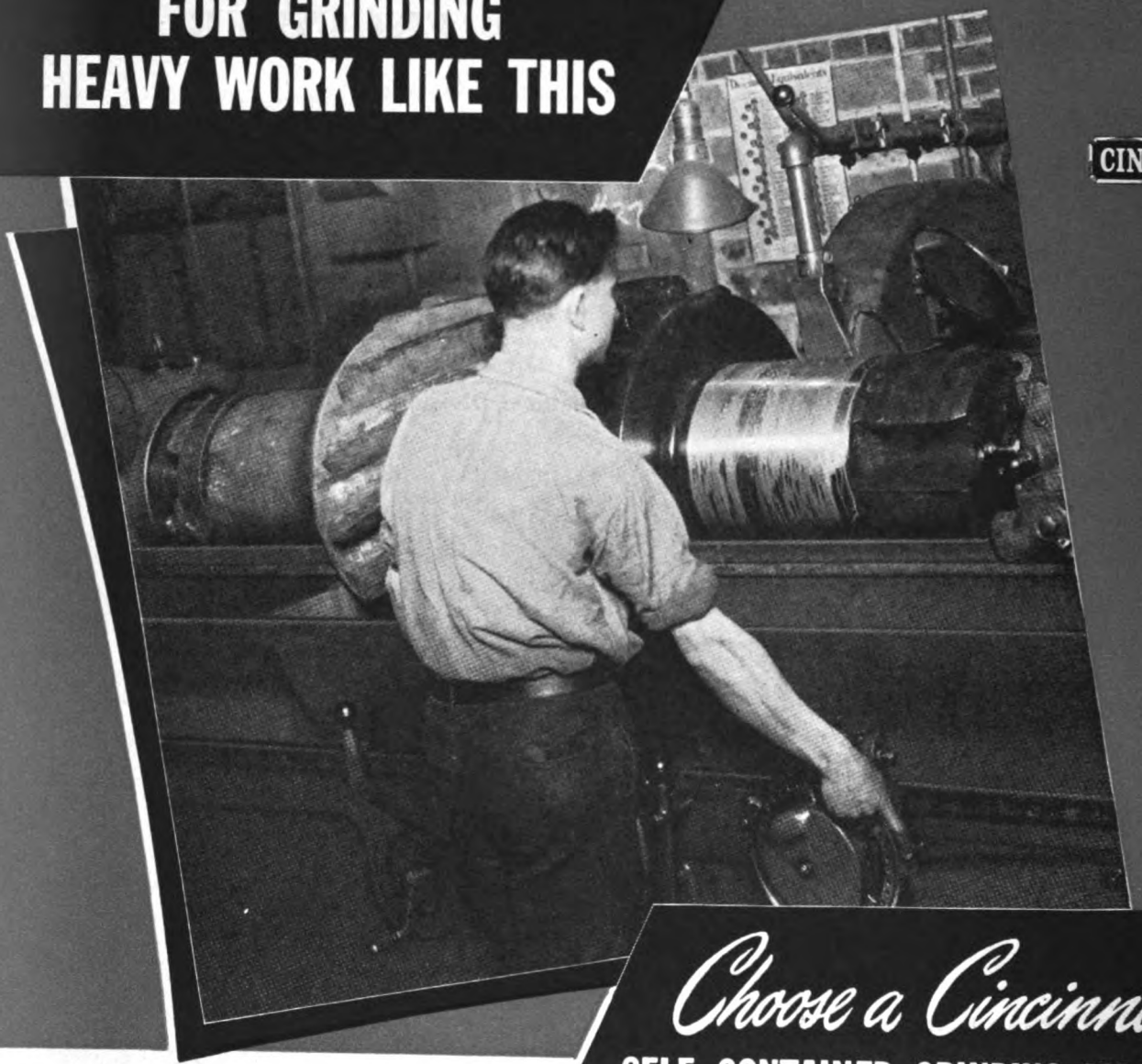

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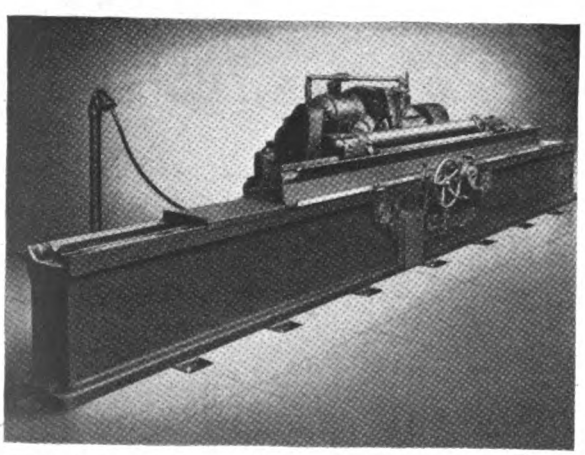

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Mechanical Division Has Active Year

A. C. Browning,
Secretary

General committee meets to transact necessary business, accept reports and assure maximum help for war effort

W. I. Cantley,
Mechanical Engineer

SINCE the annual June meeting of the A. A. R. Mechanical Division could not be held this year, the General Committee met at Chicago on June 28 and 29 to transact necessary business and consider various matters associated with increased co-operation in the war effort. On June 28, the chairmen of 11 standing committees sat in with the General Committee and presented their respective reports and recommendations bearing on the more efficient maintenance and use of locomotive and car equipment.

Present officers of the Division, who will continue to function until the next regular annual meeting, include: chairman, R. G. Henley, general superintendent of motive power, Norfolk & Western; vice-chairman, H. W. Jones, chief of motive power, Pennsylvania; executive vice-chairman, V. R. Hawthorne; secretary, A. C. Browning, and mechanical engineer, W. I. Cantley. Two new members elected to the General Committee include A. G. Kann, general superintendent of equipment, Illinois Central, in place of P. O. Christy, who held the same position on the I. C. and recently retired on account of ill health; and J. E. Goodwin, chief mechanical officer, Chicago & North Western, in place of H. H. Urbach, mechanical assistant to the executive vice-president, Chicago, Burlington & Quincy, who resigned from the General Committee on account of the pressure of other duties.

The work and responsibilities of the Mechanical Division have been greatly augmented during the war period,

but are of such a character, for the most part, as not to be reflected in committee reports which have been curtailed and reduced to minimum requirements. Among other activities relating to matters of national defense not covered in published reports, mention may be made of the work of the Car Construction Committee in contributing to the design of emergency troop sleepers and kitchen cars. Similarly, the work of the Tank Car Committee has been an important factor in conserving material and expediting the construction of this type of car which, through intensive use, has made a major contribution to the war effort.

One of the hardest working committees of the Mechanical Division is that on Loading Rules which, through subcommittees still makes almost daily contact with ordinance plants, army posts, or military supply

W. H. Flynn

O. A. Garber

J. M. Nicholson

J. E. Goodwin

General Committee
A. A. R.
Mechanical Division

A. G. Kann

H. B. Bowen

B. M. Brown

J. Gogerty

A. K. Galloway

C. B. Hitch

depots in connection with some problem of the loading of military supplies. This committee also has an inspector continuously engaged in co-operating with the armed forces in preparing shipments of military equipment for safe and satisfactory rail transportation.

A special committee, including representatives of the Committee on Wheels, the Locomotive Construction and the Car Construction Committees, has worked with the manufacturers of steel wheels with a view to reducing the number of designs of steel wheels. The wheel committee is also co-operating with manufacturers of chilled car wheels in the service testing of an improved wheel of this type. Another major effort of the wheel committee has been revision of the Wheel and Axle Manual which will be off the press about September 1. Other committees have worked hard and faithfully during the year and abstracts of their reports will be found in the following pages.

Research activities of the Mechanical Division have been increased along many lines during the last year and will be continued. Among important studies recently completed, or now in progress, mention may be made of the following: axles, crank pins, counterbalance standards, springs, journal bearings, lubricants for roller bearings, geared hand-brakes and hot-box alarms.

Car Construction Report

Proposed recommended-practice dimensions of coach seats based on data collected with Heywood-Wakefield measuring chair

T. P. Irving,*
Chairman

Statements covering freight cars ordered during period May 1, 1944, to May 1, 1945, provisions of Interstate Rule 3 with respect to new designs of freight cars, and box-car side door characteristics are available in the office of the secretary and will be held in abeyance until the next printed report of the committee.

Restrictions of Obsolete Types of Side Frames

The continued use of the old T- and L-section cast-steel side frames has been a matter of concern to your committee for some time. Reports of failures of these designs of side frames are increasing and appear to justify, first, that steps be taken to reduce the load limit permitted in cars so equipped and, second, setting up a future date after which T- and L-section cast-steel side frames shall be prohibited under cars moving in interchange service.

It is recommended that the Interchange Rules be revised to require that:

1—Effective January 1, 1946, the load limit for all freight cars equipped with T- and L-section cast-steel truck side frames is restricted to the nominal capacity of the car and a star symbol (*) is to be maintained at the immediate left of the words "LD LMT." from owners.

2—Effective January 1, 1948, cast-steel truck side frames having T- or L-section compression or tension members, prohibited under all freight cars. In interchange.

* Engineer car construction, Chesapeake & Ohio.

Couplers Formed by Welding Parts

The Mechanical Inspection Department in its investigation of reclamation practices on the various railroads has found cases where parts of two separate couplers have been brought together and welded to form a complete unit. For example, the major shank portion of one coupler is welded to the head and shank stub of another coupler, after each such detail has been worn out or failed in service.

The matter was referred to the Coupler and Draft Gear Committee who conducted tests and recommended the present emergency welding regulations and limitations for couplers and coupler yokes as set up in Interchange Rule 23. That committee recommended that, although it is felt the welding of O. K. parts from separate couplers to form a complete unit may be successfully performed if properly supervised, a rule should not be provided that will permit this practice as a general proposition.

Your committee concurs with the recommendation of the Committee on Couplers and Draft Gears and recommends that the Arbitration Committee be requested to add a new sentence to paragraph (C-1) of Section C—Emergency Welding Regulations and Limitations, Interchange Rule 23, to read: "This rule does not permit the welding of parts of different couplers to form a complete unit for application to cars in interchange service."

Lateral Movement of Brake Beams

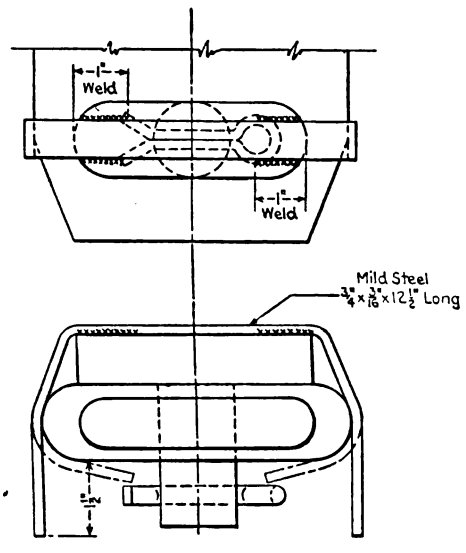
The committee recommends that the drawing for the loop-type brake-beam hanger shown on page E-6 of the Manual be revised to indicate the depth of the hanger at the center of the top and bottom bar as $1\frac{3}{16}$ in. + 0 — $\frac{1}{32}$ in. and tapered to $1\frac{3}{32}$ in. + 0 — $\frac{1}{32}$ in.

This modification is so slight it is felt the physical strength of the hanger will not be impaired to an appreciable extent. The change will permit the beam to float with the wheel and eliminate any lateral force between the shoe and head, thus reducing the wear on the toes of the brake head from this cause.

Draft-Key Retainer Lock

The matter of developing an improved type of draft-key retainer which will prevent the retainer working out and releasing the draft key, causing train separation, has been under consideration by a joint sub-committee consisting of representatives of your committee and the committee on Couplers and Draft Gears.

The committee recommends that the method of securing draft-key retainer as submitted by the joint sub-committee be adopted and added to the drawing for Standard Draft-Key Retainer shown on page C-28B of the Manual.



Draft-key retainer lock

Recommendation by the Committee on Couplers and Draft Gears that another design of draft-key retainer illustrated in the report of that committee be submitted for adoption as an alternate standard, is being studied and will be given further consideration.

Your committee has also recommended to the Arbitration Committee that a note be added following paragraph (d-3) of Interchange Rule 3, to read as follows:

"Note.—On new cars, or on existing cars where location of brake pipe will permit, draft key should be applied from the brake-pipe side of the center sill."

Reason: To facilitate inspection of the draft-key retainer. This recommendation has the concurrence of the Committee on Couplers and Draft Gears.

The committee recommends that new Note No. 16 be added to the notes now printed on page L-39B of the Manual to read:

"Note 16: Refrigerator cars having adjustable bulkheads are to be stenciled to show, in addition to the normal inside length and cubic capacity (based on bulkheads in service position), the maximum inside length and maximum cubic capacity, with bulkheads in extreme end positions. This additional stenciling to be shown in parentheses."

Welding of Car Parts

At suggestion of the Committee on Brakes and Brake Equipment, it is recommended that a new item be added to Section B of Interchange Rule 23 to read:

"Reservoirs, Auxiliary and Emergency Air Brake, Cast Iron . . . No welding permitted."

No regulations have been formulated covering welding on coupler draft keys and questions have been raised with respect to building up worn surfaces on this item.

Standard Coach-Seat Dimensions

The report of the sub-committee was approved with the understanding that the recommendations contained therein would be submitted for adoption by Letter Ballot as Recommended Practice rather than Standard Practice.

This report has been submitted to representatives of the Territorial Passenger Association for concurrence or comment, who advised as follows: "Our committee has reviewed the report and also inspected the measuring chair used in this study. In addition, we have gone over the process by which the various suggested dimensions were obtained. We are in accord with the report of your sub-committee and suggest it be submitted to the member roads as proposed.

Letter Ballot Items

It is recommended that the following recommendations contained in this report be submitted to Letter Ballot of the members.

1—Effective dates regarding T- and L-section cast-steel truck side frames.

2—Change as recommended in loop-type brake hangers to provide for taper of the top and bottom bars.

3—Change in method of securing draft-key retainer as covered by sketch.

4—Addition of new note No. 16 to cover dimension markings for refrigerator cars equipped with adjustable bulkheads.

5—Addition of new paragraph to Section B of Interchange Rule 3 to prohibit welding of cast-iron air-brake reservoirs.

6—Addition of new paragraph to Section B of Interchange Rule 3 on the reclamation of draft-gear keys.

7—Adoption as recommended practice of standard dimensions of coach seats.

Sub-Committee on Standard Dimensions for Coach Seats

The Sub-Committee on Standard Dimensions for Coach Seats contacted the principal coach-seat manufacturers as to building seats in the future to certain principal dimensions without interfering with their individual product as to design, appearance, etc., and all advised that they are willing to cooperate and that such principal dimension standardization is agreeable to them.

The Heywood-Wakefield Company appropriated a fund to assist in this study of determining such principal dimensions and constructed a special measuring chair, as well as arranged for accurate measurements of individuals under the direction of Dr. E. A. Hooton, head of the Harvard University Department of Anthropology, which specializes in accurate measurements of human anatomy, and who had made similar studies for military authorities and others.

The chair was set up at the Boston & Maine station in Boston, Mass., and the Chicago & North Western station in Chicago, where measurements were taken from 3,867 adult individuals, constituting a reasonable representative sample of the population of the United States, especially that portion of the population which habitually uses railroads.

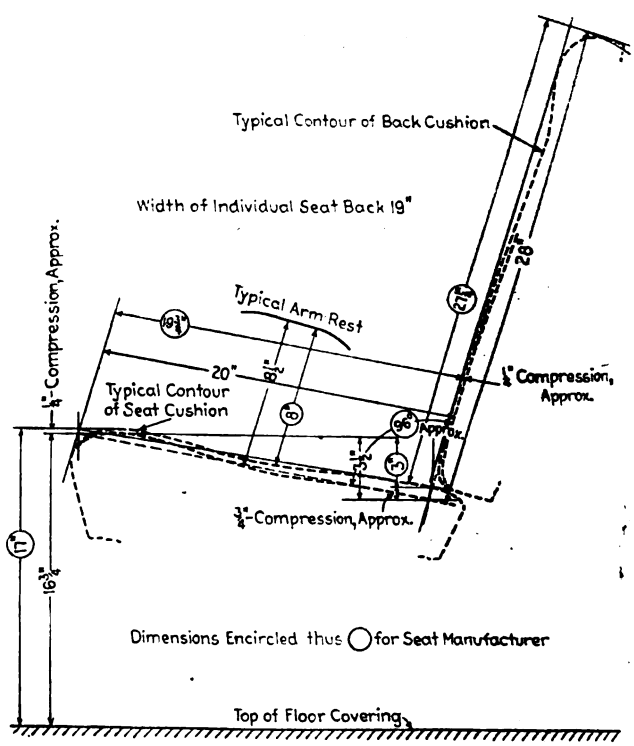
The measurements taken were as follows:

1—The seat was raised until the individual's feet were not in firm contact with the floor. The lower legs were allowed to hang straight down. A seat-length rod was then pulled out until it contacted the uppermost part of the lower leg behind the knee.

2—The seat was slowly lowered until the individual's feet rested firmly on the floor. The firmness was determined by questioning the individual and by grasping one of his feet and attempting to move it. The seat was never lowered so far that the popliteal area (the lower portion of the upper leg just behind the knee) was not in contact with the seat surface.

3—The individual was asked to place his forearm on (and parallel with) the arm rest, which was raised or lowered until the individual's shoulders were level and the angle between his upper arm and forearm was about 90 deg. This position, by the way, was described by the majority as comfortable.

4—The hip breadth was measured by bringing the arms of a calibrated hip-breadth rod together until they contacted the portions of the buttocks or upper thighs expanding to the maximum



Coach-seat dimensions proposed for recommended practice

"spread." Care was taken not to include objects in pockets and enough pressure was exerted to compress the clothing if it was loose.

5—The back height was measured by pulling up a back-height rod and placing the crutch-like end of its transverse arm (at right angles to the rod and extending forward towards the back of the subject's head) at the point of junction between the head and neck. This point, roughly called the nape of the neck, is actually the region of the first and second cervical vertebrae and is easily located in most people, even in women with long hair. During this measurement the subject was, if necessary, asked to sit erect.

6—The shoulder breadth was taken by bringing the arms of a shoulder-breadth rod together until they touched the individual's deltoid muscles (the point of maximum lateral expansion). If the individual tended to hold his arms out from his body, this was corrected by requesting him to keep his arms against his body.

7—The individual was asked to step onto the scales where his height (within ¼ in.) and his weight (to the nearest pound) was recorded. Average weight of all subjects was found to be 152.8 lb. The average height of males was found to be 69 in., and for females, 64.9 in.

In addition to these measurements, the following was obtained: Age (38.45 years for males and 35.55 for females); birthplace (number of foreign born is proportional to total adult population); type of heel, for females only (12.5 per cent low heels, 52.3 per cent medium heels, and 35.2 per cent high heels); whether or not shoes were habitually removed when traveling by train, for females only (70.5 per cent do not have any desire to remove shoes when riding on train).

In order to make a representative study, an effort was made to: (1) prevent any age group (as, say, individuals 18 to 20 years old) from becoming greatly superior numerically to the other age group; (2) obtain an equal number of males and females; (3) obtain people from all economic and social levels.

All information obtained was statistically arranged and the following principal dimensions were determined:

Seat Height

This is probably the most important measurement and in order to ascertain the distance from the popliteal area to floor (seat height), the thigh could be parallel with the floor and knee should be bent at right angles with all pressure relieved at the popliteal area. It was found that 16¾ in. seat height at the front edge was the most desirable and while this height may be a trifle low for tall people, it is not uncomfortable for short people; whereas a seat too high is distinctly uncomfortable for short people—the long-legged can adjust themselves to this height by resting the feet on the floor forward of the vertical front edge of the seat to the floor.

Seat Length and Depth

Two problems were considered:

1—The long-legged must be accommodated, since a seat length too short results in the underside of the thigh near the knee (the popliteal area) pressing heavily on the edge of the seat. This pressure is highly uncomfortable if maintained for any length of time.

2—The short-legged must be accommodated, since a seat length too long prevents the normal bending of the knee unless the individual sits forward and away from the back of the seat.

It developed that a seat length, or depth, of 20 in. would accommodate 90 per cent of all individuals.

If the back of the seat is convex because of upholstery, then the seat length, or depth, must be increased correspondingly.

Seat Back Height

The requirements for this height is that support be furnished at the base of the skull and a height of 28 in. was found to be most suitable. This dimension can be lowered in this way only if a compensating increase in length of seat is made so that tall individuals can slump down.

Angularity of Seat Back

An angle of approximately 96 deg. was found, in the past, to be a good general average.

Hip and Shoulder Breadth

Nineteen-inches width of seat and seat back was found to be the most practical, which would allow ample space between individuals. It was found that small individuals are as comfortable, or more comfortable, in a wider seat than in a seat the width of which is commensurate with their shoulder breadth. This distance also allows for top coats, padded shoulders, and some degree of movement.

Arm-Height Rest

The measurement depends chiefly on the proportion of the length of the upper arm to the length of the torso. Thus, a man with a long torso and long arms can have the same elbow height as a man with a short torso and short arms. An arm rest height of 8½ in. was found to be the most convenient and a higher rest required either an uncomfortable hitching up of the shoulders, or extra lateral space on the seat so that elbows may hang inside the rest.

Allowance for Compression in Cushions

Compression is not a precise problem when humans are involved. Compression depends on the amount of weight applied to the surface to be compressed, the area compressed by the weight, distribution of the weight along the area of compression, elasticity of the cushion, and variation in the compressibility near the supporting frame of the cushion and further from it. Compression figures developed must be considered as general only, as a person does not always sit upright in one defined spot and the slightest shift of weight effects compression. Also, the variations of body builds affect the placements of weights and thus compression.

Dimensions Proposed as Recommended Practice for Future Coach Seats*

	Dimension required per survey	Correction for compression	Dimension required for seat manufacturer	Range of 33 designs of seats as submitted
Seat height at front edge of seat, in.	16¾	¼	17	16 to 18⅞
Seat length, or depth, in.	20	¼	19¾	18 to 21
Seat slope, in.	3½	..	3	3 to 3¾
Seat back height, in.	28	¾	27¼	22¾ to 28½
Angularity of seat back, deg.	96	..	96 (Approx.)	90 to 110
Width of seat and seat back, in.	19	..	19	17½ to 19½
Arm-rest height from top of seat, in.	8½	½	8	5 to 9¾

* Submitted by seat manufacturers and railroads.

Consideration was given to the possible standardization of following additional coach-seat details; however, this was not found practical: Shape of seat and back cushions, overall width of coach seats, reclining of seat backs, rotating and reclining mechanism, arm rests, foot rests, seat pedestal, and seat spacing.

Sub-committee wishes to express their appreciation to the Haywood-Wakefield Company in giving their valued assistance in this study.

The chairman of the sub-committee is J. K. Peters, mechanical engineer, Denver & Rio Grande Western.

Report of The Arbitration Committee

Some rules clarified, procedure under others simplified—No extension for use of welded T- or L-section truck side frames

J. P. Morris,*
Chairman

During the year Cases 1803 to 1811, inclusive, have been decided and copies sent to the members. Due to increasing failures of truck side frames having T- or L-section compression or tension members, no extension beyond January 1, 1946, is recommended for the requirement in Rule 3 prohibiting application of such welded frames.

With the concurrence of the Committee on Brakes and Brake Equipment, it is recommended that the requirement in Rule 3 with respect to metal badge plates for brake levers be modified to include only cars equipped with AB brakes, to become effective July 1, 1946. With the concurrence of the Committee of Brakes and Brake Equipment, it is also recommended that requirement in this rule covering nominal braking ratio for cars with single capacity brakes be reduced from 60 per cent to 50 per cent of the empty car weight.

* General mechanical assistant, Atchison, Topeka & Santa Fe.

Modification of Rule 17 is recommended to provide in cases of owner's defects that bolts substituted for rivets where rivets are standard to the car shall be classed as temporary repairs, no bill, instead of improper repairs as now constituted.

No extension beyond January 1, 1946, is recommended for the requirement in Rule 23 prohibiting the welding of truck side frames having T- or L-section compression or tension members.

With the concurrence of the Committee on Wheels, it is recommended that a new Fig. 4-D, which is a reproduction of Fig. 130 of the Wheel and Axle Manual, be added to the Code.

An additional paragraph in Section B of Rule 112 is recommended to provide a basis for arriving at reproduction costs for freight equipment cars where definite per pound prices are not established.

With the concurrence of the Committee on Car Construction, a new paragraph (g) is recommended for addition to Passenger Car Rule 2 requiring approval by the Mechanical Division of new or modified designs of passenger car trucks.

Addition of new Rule 11 to the Passenger Car Code is recommended to provide for material ordered from the owner for repairs to passenger equipment cars.

The Committee does not feel that any of the modifications included in its report necessitate submission to letter ballot.

Rule 3

The Committee recommends that effective dates for various requirements in the present rule, as listed below, now set at January 1, 1946, be extended to January 1, 1947:

Section (b), paragraph (9)—Braking power: braking ratio.
Section (c), paragraph (10)—Couplers having 5-in. by 5-in. shanks.
Section (c), paragraph (11)—Couplers having 5-in. by 7-in. shanks.
Section (c), paragraph (12) — Couplers, bottom rotary operated, not equipped with assembled riveted-type lock-lift lever and toggle.
Section (t), paragraph (10)—Tank cars: metal placard holders.
Section (u), paragraph (4)—Class E-3 cars not to be accepted from owner.

The matter of extension in effectives dates for requirements involving AB brakes and bottom-rod and brake-beam safety supports is before the General Committee.

The Committee recommends that no extension beyond January 1, 1946, be granted in the effective date of the requirement in Paragraph (t-3) of this rule prohibting the application of welded truck side frames having T- or L-section compression or tension members.

Reason: This requirement has appeared in the rules since August 1, 1938, as result of letter ballot Circular DV-936. Due to increasing failures of these designs of side frames, it is felt no further extension in effective date of the requirement should be granted.

The Committee recommends that a new note be added to Paragraph (b-1) of this rule, effective August 1, 1945, to read as follows:

Note: Cars equipped with hangerless type brake beams, used with Unit trucks, will be accepted in interchange.

Reason: To provide for acceptance in interchange of cars equipped with Unit trucks having hangerless type brake beams.

The Committee recommends that Paragraph (b-7) of this rule be modified, effective August 1, 1945, as follows:

Proposed Form: (b-7) Brake levers: Metal badge plate meeting A. A. R. requirements and fastened to underframe in an accessible location preferably near the air brake cylinder and on the same side of the car, showing dimensions of the brake levers standard to the car, required on all cars built new or rebuilt on or after August 1, 1929. Effective July 1, 1946, the foregoing requirement will also apply to all cars equipped with AB brakes. From owners.

Reason: It is felt cars in service built prior to August 1, 1929, which have not been equipped with badge plates, are mostly cars with brakes of miscellaneous designs for which it is difficult to standardize on suitable badge plates, and that such cars will be retired from service when conditions permit; and, in the meantime, acceptance of such cars from owners or in interchange should not be prohibited. However, if such cars are equipped with AB brakes, the brake arrangement will be more or less standard and no hardship is created in providing the necessary badge plates. This recommendation has the concurrence of the Committee on Brakes and Brake Equipment.

The Committee recommends that Paragraph (b-9) of this rule be modified, as follows:

Proposed Form: (b-9) Braking power: On and after January 1, 1946, all freight cars offered in interchange having single capacity brakes shall have a nominal braking ratio of not less than 50 per cent nor more than 75 per cent of the empty car weight, based on a brake-cylinder pressure of 50 lb. per sq. in., except refrigerator cars which shall have a nominal braking ratio of not less than 50 nor more than 60 per cent of the empty car weight, based on 50 lb. per sq. in. brake-cylinder pressure. In interchange.

Reason: In view of minimum braking requirements having been provided for the loaded car, the 50 per cent minimum will provide adequate braking for the empty cars, as recommended by the Committee on Brakes and Brake Equipment.

The Committee recommends that Paragraph (c-12) of this rule be modified, as follows:

Proposed Form: (c-12) Coupler, A. A. R. Standard Type E bottom rotary operated, must be equipped with assembled riveted-type lock-lift lever and toggle E-14 (instead of separate lock-lift lever E-8 and separate toggle E-7), on and after January 1, 1946. In interchange.

Reason: To clarify the intent.

Rule 5

The Committee recommends that the second paragraph of Rule 5 be modified, effective August 1, 1945, as follows:

Proposed Form: To justify bill, repairs authorized by defect card must be made within two years from the date of first receipt of car on home line, except wrong repairs, which must be corrected within nine months from date of first receipt of car on home line. However, if wrong repairs of brake beams, brake hangers, brake levers, brake rods, carrier irons, couplers and parts, draft stops, side bearings, door fixtures, bolts in place of rivets, or wrong size bolts or pins, are not corrected within nine months from date of first receipt of car on home line, or not corrected on any line within one year from date of such wrong repairs, counterbill for correcting same is prohibited.

Reason: Car owner should absorb expense of correction after these details have given the specified length of service.

Rule 9

The Committee recommends the following requirement be included in this rule opposite item of Wheels and Axles, R. & R., effective August 1, 1945:

Where axle applied or removed is of tubular (hollow) design, so state.

Reason: To provide the owner with information as to performance of this type of axle.

Rule 10

The Committee recommends that the first sentence of the second paragraph of this rule be modified and a new last sentence added to read as follows:

In all cases of multiple-wear wrought-steel wheels, the amount of service metal in the tread must be shown before and after turning, measured from the center of the tread to the condemning line which is located ¾ in. above the measuring point; also show amount of service metal on the other wheels applied, based on full flange and tread contour. It must also be stated whether such wheels have standard full flange and tread contour. This information must be reported to car owners regardless of whether or not repairs are chargeable to owners. For one-wear wrought-steel wheels, see Section (i) of Rule 98.

Reason: To eliminate confliction between Rules 10 and 98.

Rule 17

The Committee recommends that the first sentence of Section (d) of this rule be modified, effective August 1, 1945, as follows:

Proposed Form: Bolts substituted for rivets, in cases of owner's defects, where rivets are the standard of the car, are considered as temporary repairs, no bill, except where used in securing ladders, ladder treads, handholds, sill steps and uncoupling lever brackets on all cars of all types; also, proper to use bolts for securing coupler and draft-gear supports on tank cars; except, that in no case shall bolts be substituted for rivets which pass through the shell or metal jacket of the tank of tank cars.

Reason: To eliminate the use of defect cards, also charges, for repairs of this nature.

Rule 19

The Committee recommends that no extension beyond January 1, 1946, be granted in effective date of requirement in Item 14 of this rule prohibiting the application of welded truck side frames having T- or L-section compression or tension members.

Rule 21

The Committee recommends that Paragraph (c) of this rule be modified, effective August 1, 1945, as follows:

Proposed Form: Rule 21. Bills may be rendered against car owners:

(c) For other temporary repairs at car owners' expense, only when authorized by car owner, except as otherwise provided in Note F of Rule 44.

Reason: To eliminate confliction with Rule 44.

Rule 23

The Committee recommends that no extension beyond January 1, 1946, be granted in effective date of requirement in this rule prohibiting the welding of truck side frames having T- or L-section compression or tension members.

Rule 60

In view of Circular DV-1082 dated February 15, 1945, providing the C. O. T. & S. of AB brake equipment on cars stenciled "AB Brake—Experimental," Note 2 following Section (m) of this rule, reading as follows, has been eliminated:

Note 2: Cleaning periods established for AB type freight brake equipment are not applicable to cars bearing stencil "AB Brake—Experimental." Such brake equipment must be handled in accordance with Circular No. DV-829.

Rule 63

The Committee recommends that Paragraph (4) of this rule be modified by addition of italicized words, to read as follows:

(4) Brake beam hanger pins, bolts or *brake connection pins,* originally in excess of one inch in diameter, if worn to 7/8 in. or less at any point.

Reason: To provide wear limit for brake connection pins.

New Fig. 4-D

The Committee recommends that a new Fig. 4-D, which is a reproductions of Fig. 130 of the Wheel and Axle Manual, be added to the Code. (Present Fig. 4-D to be relocated as new Fig. 4-E and necessary references to be made in Fig. 4-A, Rule 76 and Passenger Rule 7 to harmonize.

Reason: To clarify the intent, as recommended by the Committee on Wheels.

Rule 87

The Committee recommends that Section (a) of this rule be modified, effective August 1, 1945, as follows:

Proposed Form: (a) Any company making improper repairs by using material which the repairing line should carry in stock, as prescribed in Rule 122, is solely responsible to the owners, with the exception of the cases provided for in Rule 57. Such improper repairs must be corrected within nine months after the first receipt of the car on home line, to justify the bill. However, if wrong repairs of brake beams, brake hangers, brake levers, brake rods, carrier irons, couplers and parts, draft stops, side bearings, door fixtures, bolts in place of rivets or wrong size bolts or pins, are not corrected within nine months from the date of the first receipt of the car on home line, or not corrected on any line within one year from the date of such wrong repairs, counterbill for correcting same is prohibited. In all cases of improper repairs where defect card is attached to car, a notation to that effect should be made on the billing repair card.

Reason: Car owner should absorb expense of correction after these details have given the specified length of service.

Rule 94

The Committee recommends that the first paragraph of this rule be modified, effective August 1, 1945, as follows:

Proposed Form: For repairs made on authority of A. A. R. defect card, the defect card, together with a billing repair card, must accompany the bill, subject to the requirement that repairs must be made within two years from the date of the first receipt of the car on the home line, except wrong repairs which must be corrected within nine months from the date of the first receipt of the car on the home line, to justify the bill. However, if wrong repairs of brake beams, brake hangers, brake levers, brake rods, carrier irons, couplers and parts, draft stops, side bearings, door fixtures, bolts in place of rivets, or wrong size bolts or pins, are not corrected within nine months from the date of the first receipt of the car on the home line, or not corrected on any line within one year from the date of such wrong repairs, counterbill for correcting same is prohibited. In the case of repairs covered by defect card, if the owner changes the original standard of parts so involved, the charge must be no greater than if the original design had been followed.

Reason: Car owner should absorb expense of correction after these details have given the specified length of service.

The Committee recommends that the last paragraph of this rule be modified, effective August 1, 1945, as follows:

Proposed Form: No bill shall be rendered for repairs not made. However, where a car reaches home with the defect cards attached under provisions of Rule 112, or with other unfair usage damage covered by defect card, and owner elects to retire instead of repair car, charge may be made for material and labor as would have been required for repairing or renewing items actually listed on the defect card, excluding labor and material for undamaged associated parts except where the allowances in Rule 107 include labor for R. & R. of such associated parts. In no case, however, shall the total bill exceed the A. A. R. depreciated value of the car, less salvage.

Reason: To simplify the preparation of bills under the provisions of this rule. It is felt the small amount of labor charges involved can consistently be included.

Rule 98

The Committee recommends that Paragraph (c-5) of this rule be modified, effective August 1, 1945, as follows:

Proposed Form: (5) Serviceable experimental cored hub wheels marked "A. A. R. X." when removed from service on account of defect in axle or mate wheel, shall be credited as scrap except when removed on account of Rule 32 or Rule 84 condition in which event second-hand credit must be allowed for such undamaged wheel or wheels.

Reason: Car owners invariably do not desire to have these wheels returned and they are scrapped. This change will eliminate considerable unnecessary correspondence and has the concurrence of the Committee on Wheels.

Rule 107

The Committee recommends that preamble to this rule be modified, as follows:

Proposed Form: Rule 107. The following table shows the labor charges which may be made for performing the various operations shown. The labor allowances include all work necessary to complete each item of repairs, unless the rules specifically provide that in connection with the operation additional labor may be charged for the R. and R. of any item which must necessarily be R. and R. in connection therewith.

The labor charges in this rule, as well as Rules 98, 101 and 111, in addition to including the actual labor cost of performing the work, include the following items of indirect expense:

Wages of foremen, assistant foremen, gang foremen, inspectors, clerks, messengers, watchmen, janitors, laborers, etc. working in connection with freight car repairs.

Proportion of expense of operating power plants, power purchased, shop switching, wages of operators and directors of cranes and tractors, tool room attendants, machinery oilers, and other facility operators, tools, fuel, lubrication, water, other supplies, etc.

Proportion of salaries and expenses of chief mechanical officers and their office and supervisory forces, regional supervisory and accounting forces.

Proportion of expense of maintenance of facilities (tracks, buildings and machinery) and fixed charges on facilities such as interest, taxes, depreciation and insurance on land, track buildings and machinery.

Workmen's compensation, carriers' taxing act of 1937, railroad unemployment act and vacations with pay.

No element of profit is included in the A. A. R. labor charges.

Reason: To more clearly define the elements of costs incorporated in the overhead allowance.

Rule 112

The Committee recommends that Paragraph 2 and 3 of Section B of this rule be combined as new paragraph 2 and a new paragraph 3 added, effective August 1, 1945, to read as follows:

2. Where cast- or pressed-steel extensions are used and riveted to metal center or draft sills between bolsters they shall be considered as continuous. The cover plate may be part top and part bottom, providing the specified length is covered.

3. Where per pound settlement prices are not provided and the rules specify settlement on reproduction cost basis, cost or reproduction in kind at date of destruction shall be obtained by adjusting the original cost to date by the relation of costs as between those in the year built and in year prior to the date destroyed, on the basis of percentages of costs as issued by Joint Equipment Committee—Costs of Railroad Equipment and Machinery—published by the A. A. R. Finance, Accounting, Taxation and Valuation Department, Washington, D. C.

Reason: To establish an equitable and uniform basis for arriving at reproduction cost of freight equipment cars where per-pound prices have not been established.

Passenger Rule 2

The Committee recommends that the effective date of Paragraph (e) of this rule with reference to equipping all-steel or steel-underframe cars with cardboards or suitable receptacles for accommodation of defect and joint-evidence cards, and effective date of Paragraph (f) covering the application of brake-shoe spark shield to passenger train cars having underneath exposed wood parts over wheels, both requirements now being set at January 1, 1946, be extended to January 1, 1947.

Reason: The present situation justified these extensions.

The Committee recommends that a new Paragraph (g) be added to this rule, effective August 1, 1945, to read as follows:

(g) No car equipped with trucks of an untried type, whether trucks are built new or existing trucks with construction substantially changed, shall be offered or accepted in interchange, nor accepted from the car owner, until such trucks have been approved by the Mechanical Division of the Association of American Railroads.

Reason: To require approval of new or modified designs of passenger car trucks, in connection with revised definitions for passenger-train cars adopted by letter ballot this year. This recommendation has the concurrence of the Committee on Car Construction.

Passenger Rule 7

The Committee recommends that the third sentence of Paragraph (e-1) of this rule be modified by the addition of italicized portion, effective August 1, 1945, to read as follows:

Axles standard to the car must be maintained, *except the 1940 A. A. R. standard passenger car axle may be substituted for the former standard axle, charge and credit to be on basis of material applied and removed. In case of handling line responsibility, betterment charge may be made for the 1940 A. A. R. standard passenger car axle on basis of its second-hand value. When former standard is substituted for the 1940 standard, proper charge and credit must be made and defect card issued for labor only.*

Reason: To provide for substitution of 1940 A. A. R. standard passenger car axle and charges and credits in connection therewith.

The Committee recommends that Section (f-12) of this rule be modified, as follows:

Proposed Form: (12) Thin Rim—Wrought-steel wheels: If the tread is worn so that tread thickness is 1 in. or less. See Fig. 4.

Steel-tired wheels: If tread is worn to within ¼ in. of measuring line (inside edge of limit of wear groove) as shown in Figs. 1, 2 and 3.

Service metal and tread thickness of wrought-steel wheels shall be measured by the A. A. R. standard steel-wheel gage or its approved equivalent, applied as shown in Figs. 4-A and 4-D of the freight code, with due consideration to 1 in. thickness condemning limit for passenger car service.

Reason: To clarify the intent, as recommended by the Committee on Wheels.

Passenger Rule 11

The Committee recommends that new Rule 11 be added to the passenger code, effective in the August 1 supplement, to read as follows:

Rule 11. Material ordered from car owner shall be handled as outlined in Rule 122 of the freight code.

Reason: To clarify the intent with respect to material ordered from owner for repairs to passenger cars.

Passenger Rule 22

The Committee recommends that first and second paragraphs of third note following Item 60 of this rule be modified, effective August 1, 1945, as follows:

Proposed Form: Notes Material not listed above, but listed in Rule 101 of the freight car rules (if same as that used on freight car) shall be charged at prices shown in Rule 101. All other material to be charged at net store department cost.

Reason: To clarify the intent with respect to material ordered from the owner for repairs to passenger cars.

Lubrication Of Cars and Locomotives

The report recommends that the roll method of packing be submitted to letter ballot for inclusion as alternative on Rule 66

J. R. Jackson,* Chairman

Returns from the survey, made during the year of practices in packing journal boxes, indicate that the one-piece method of packing is followed by the majority of member roads. Under Rule 66, the method of application of the packing has been left optional, although the one-piece method has been set up as preferable since 1938.

The question of a mandatory method of packing boxes has been considered but the committee has not been able to agree on any one method. The committee holds that any of several methods of packing boxes will give satisfactory results and that the matter should remain optional.

Results of Survey of Methods of Packing Journal Boxes

Journal boxes on—	Number of member roads using: One-piece* method	Roll method	Miscel. methods
(1) Locomotive tenders	62	32	2
(2) Passenger equipment cars:			
(a) On-line service	56	30	2
(b) Interchange service	57	29	2
(3) Freight equipment cars:			
(a) On-line service	70	23	2
(b) Interchange service	70	23	2

* With back roll, Fig. 1, Rule 66.

Recognizing that the roll method is preferred over the one-piece method by approximately 25 per cent of the member roads covered by the survey, the committee has revised the A. A. R. standard practice, as covered by Par. (b), Rule 66, to include the roll method and show this method by drawing to amplify Fig. 1 in the present standard method of packing made a part of Rule 66. It is recommended that the revision shown in Exhibit A be submitted to the Association as a letter-ballot item.

* Engineer of tests, Missouri Pacific.

Tabulation Compiled from Monthly Freight Car Hot-Box Statistics as Reported by the A. A. R.

Month	Total freight-car mileage				Total car set-outs*				Average miles per set-out*			
	1942	1943	1944	1945	1942	1943	1944	1945	1942	1943	1944	1945
January	..	2,999,962,588	3,293,864,472	3,016,370,744	..	7,760	5,978	8,263	..	386,593	550,999	365,045
February	..	2,865,616,217	3,174,542,468	2,888,302,726	..	8,698	6,442	8,468	..	329,456	492,788	340,966
March	..	3,272,300,869	3,454,052,285	3,430,648,710‡	..	9,067	7,177	9,947‡	..	360,902	481,267	344,893‡
April	..	3,233,014,225	3,342,340,489	3,341,069,956‡	..	8,545	7,274	10,633‡	..	378,452	459,491	314,217‡
May	..	3,412,690,321	3,464,606,409		..	11,598	12,305		..	294,147	281,561	
June	..	3,231,415,378	3,327,747,609		..	19,625	16,619		..	164,658	200,238	
July	..	3,430,981,134	3,443,235,673		..	21,313	16,698		..	160,981	206,206	
August	..	3,462,317,281	3,443,448,023		..	18,296	15,381		..	189,239	223,877	
September†	3,191,618,297	2,401,363,195	3,318,593,893		13,941	12,203	10,967		228,938	278,732	302,598	
October	3,402,371,306	3,475,645,092	3,490,271,418		9,204	7,945	7,813		369,662	437,463	446,726	
November	3,172,846,122	3,222,709,578	3,253,587,840		5,833	5,081	5,078		543,948	634,267	640,975	
December	3,026,680,774	3,182,786,375	3,112,425,198		5,237	4,968	4,877		577,942	667,532	638,184	

*Account hot-boxes.
†Records begin September, 1942.
‡Figures for March and April, 1945, added by the editor.

Roller Bearing Lubrication

During the year roller-bearing assemblies for 5½-in. by 10-in. journal boxes from the S. K. F. and the Hyatt companies have been delivered to the Indianapolis laboratory and some exploratory work completed with the S. K. F. assembly installed on the testing machine and using stock oils furnished by committee member roads. The work at the Indianapolis laboratory has been carried along by three resident representatives, each spending two days a week while the plant is being operated. The program embraces study and rating of the lubricants on the basis of lubrication, stability and action on the metals. From the work done to date, the indications are that the committee is developing valuable information relative to roller bearing lubricants which it is hoped will permit of recommendations leading to more uniformity of practice and improvement in performance in the field of lubrication of roller bearing equipment on the railroads.

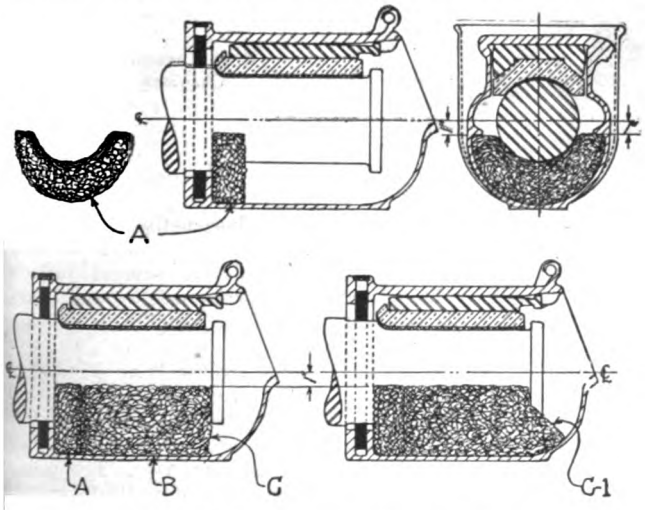


Fig. 1—Proposed standard one-piece method of packing journal boxes

It is recommended that this research project be continued during the coming year.

Journal-Box Lids

The study of journal-box lids has been progressed during the year by a subcommittee collaborating with representatives of the Car Construction Committee and the manufacturers. The subcommittee has extended its activity to include a survey of journal-box lids on cars in service along with a check of specimen lids furnished by the manufacturers to the proposed revised specification mentioned in our 1944 annual report.

The work of this subcommittee will be carried along during the coming year and recommendations for changes in Spec. M-120—Journal Box Lids, submitted as a letter ballot item as soon as possible.

Packing-Retaining Devices

The committee has continued to study the more promising developments in waste-retaining devices and, based on impact tests of cars equipped with the packing retainer-spring device designated as the Hold-Rite Packing Retainer, as well as service tests on cars of railroads represented on the committee, feels warranted in approving the use of this patented device for the purpose of holding packing in place in the journal box and to assist in prevention of waste grabs.

There are no restrictions as to the use of the device on interchange cars. However, in order to protect and continue in service such devices as have been applied to cars moving in interchange service, it is recommended that a note be included under Rule 66 in the interchange code to provide that this device should be reapplied when in serviceable condition and standard to car, when wheels are changed, journal bearings removed or journal boxes repacked. While it is felt no penalty should be provided at this time for failure to renew the spring retainer, it is considered that a note in the interchange code directing attention to the matter will be helpful in maintaining the device in service.

Tabulation of the monthly statements of freight-car hot-box records on all A. A. R. member roads, as compiled by the secretry's office, starting with September, 1942, and through February, 1945, is presented in one of the tables. This is an extension of a similar tabulation presented in our 1944 report and is here brought up to date as information.

Accidents Due to Hot Boxes and Burned-off Journals

This study is being progressed through the research program being carried out at Altoona, Pa., under the direction of a Committee on Hot-Box Alarm Devices set up in accordance with the lubrication committee's recommendations at the 1944 annual meeting. The lubrication committee has held two meetings at Altoona during the year to give the members the opportunity of keeping informed as to the progress of the investigation of hot-box alarm devices.

The lubrication committee again emphasizes the importance of magnaflux inspection of all journals involved in overheatings where journal surfaces and ends of axles show pronounced coloring. It is recommended that Par. 355 (o) of the Standard Rules Covering Wheel Shop Practice in the Wheel and Axle Manual, as made mandatory through Interchange Rule 69, be enforced.

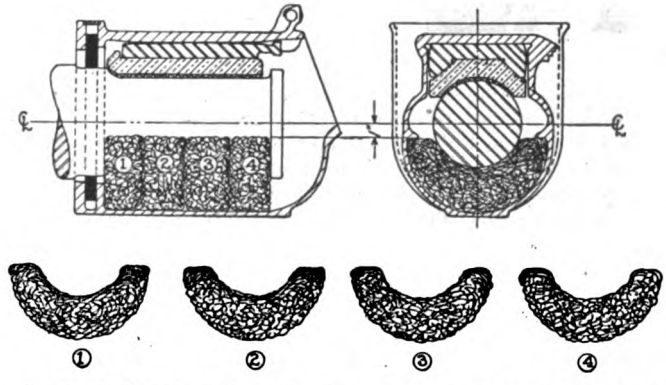


Fig. 2—Roll method of packing boxes—No. 4 roll sized to fill without additional small piece

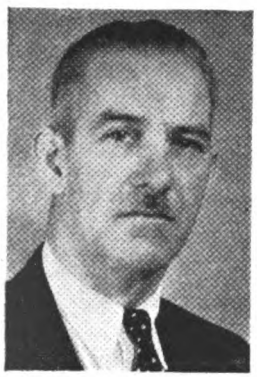
Exhibit A—Journal Boxes, Standard Method of Packing

Proposed Form. (Sec. 4, Sub. Sec. (b)) Body of Packing—Apply sufficient packing in one piece, as shown in Fig. 1, or in rolls, as shown in Fig. 2, to firmly fill the space under the journal so as to prevent settling away, care being taken to have packing bear evenly along the full length of the lower side of the journal.

(*c*) *One-Piece Method*—This is best accomplished by placing the packing across the full width of the mouth of the journal box and allowing the strands to hang down outside, always adding more packing before placing the hanging strands inside the box This has the effect of binding all of the body of the packing in one mass. The top of the packing must be at least 1 in. below the center line of the journal, along the sides, to insure against the waste rolling under the bearing. After the body of the packing has been applied firmly from the back roll to the inner or back face of the journal collar, it must be finished off at the front or outer end, straight down from the inside face of the journal collar as shown at *C* Fig. 1, or may be inclined toward the front of the box as shown at "C-1," Fig. 1. No loose ends or threads should protrude at the sides or ends, such ends being carefully tucked under the sides of the packing; nor should any pieces of packing be laid along the side of the journal, as such pieces may become caught under the bearing and cause a hot box.

(*d*) *Roll Method*—This is best accomplished by lightly twisting prepared packing, made by the box packer, by hand, of suitable size, with the ends turned under, to fill the space between the journal and journal box, exactly as now in use as the back roll in Fig. 1. The other three rolls to be loosely matted prepared packing, with the ends turned under and of sufficient length and diameter to fill the remaining space under the journal, marked Rolls 2, 3 and 4 in Fig. 2. The loosely-matted packing must be firmly applied from the back roll to the inner or back face of the journal collar and must be finished off at the front or outer ends, straight down from the inside face of the journal collar, as shown for Roll 4, Fig. 2. No loose ends or threads should protrude at the sides or ends and any loose ends should be carefully tucked under the sides of the packing. The original subsection (d) of Sec. 4 is redesignated (e).

Report on Loading Rules



Changes pending involve special army supplement 2, wood and steel products, items of machinery and industrial equipment

W. B. Moir,* Chairman

The committee submits the following report on the subjects handled since its last report dated May 23, 1944.

The 1945 issue of Rules Governing the Loading of Commodities on Open Top Cars, in addition to incorporating all information contained in Supplements 1 and 2, as well as Sec. (B) of the 1944 report, also includes a number of additions and revisions, whole or in part, namely: Additions, Figs. 21, 79-C, 79-D, 79-E, 79-F and 209-B1; revisions in Rules, 3, 4, 5, 6, 9, 10, 12, 13, 15. 16, 21 and Table 2, and in Figs. 6, 6-A, 6-B, 35, 35-A, 36, 43, 65, 65-C, 76, 79, 84-A, 110, 111, 171, 205, 216 and 217.

The following subjects are still under consideration by the committee and will entail revision of present figures and specifications, or formulation of new methods of loading: Lumber, piling, poles, box shooks, girders, bars, plates, sheets, structural shapes, metal tropical huts, wire mesh, machinery, wire rope on reels, boilers, cranes, corn pickers, threshers, tractors, ingot moulds, hot tops, clay pipe, automobiles.

A revision of Special Army Supplement 2 is pending, which will include revisions of existing Figs. A, B, C, D, F, G, H, J and K, and incorporate definite specifications and drawings for the following units: ¼-ton 4-by-4 trucks, single- and double-deck, also in inclined position; truck trailers, 45-ton tank transporter; trailer portion of tank recovery unit; 2½-ton 6-by-6 trucks in steel floor cars; two-wheel cargo trailers; M-4 medium tanks, wire tied; M-26 heavy tanks, wire or rod-tied.

* Chief car inspector, Pennsylvania.

Locomotive Construction

Trucks of Diesel switchers being standardized—More steam-pipe sizes proposed—Details of boiler design recommended

H. H. Lanning,* Chairman

During the past year the Committee on Locomotive Construction has held but two meetings. Its activities have been seriously restricted by wartime conditions; however, several subjects referred to us have been handled by correspondence and others which are now under consideration will be handled in the same manner.

On May 1, 1945, restrictions placed by the War Production Board upon the manufacture of rolled steel wheels for railroad equipment (Order No. L-211) were rescinded. Under this order the manufacturers of rolled steel wheels were permitted to produce only wheels of certain standard designs and sizes. The manufacturers are still under heavy commitments to our allied countries and to builders of equipment intended for use in those countries. In view of these commitments, manufacturers state that they can supply wheels needed by American railroads only by the avoidance of a return to the multiplicity of designs and sizes in use at the beginning of the war.

It is obvious that the interest of both manufacturers and consumers of rolled steel wheels can best be served by the adoption of the smallest number of standard designs and sizes which can be reasonably made to meet requirements. To this end, representatives of this and other committees of the Mechanical and Electrical Sections, A. A. R., are co-operating with duly accredited representatives of the rolled steel wheel manufacturers. Definite progress has been made and it is expected that the work of standardization will be completed at an early date, at which time recommendations will be promptly made for submission to letter ballot.

It is recommended that the item covering additional dry pipe and steam pipe sizes and the changes in page F-6A of the Manual, be submitted to letter ballot.

[The following sub-committee reports were presented by the committee.—Editor.]

Oil Electric Locomotives

The sub-committee on this general subject is following a number of items and submits the following report:

* Mechanical engineer, Atchison, Topeka & Santa Fe.

URVEY OF DIESELS AND TABULATION OF PERFORMANCE STATISTICS

In view of the conditions it appeared impracticable to collect mplete information and it was decided to forego the statistics ıtil such time as we can again obtain complete and satisfactory plies to questionnaires on this subject.

STANDARDIZATION

To date the subcommittee has studied the matter of standardation of trucks and truck parts of switching locomotives only. has been developed that the biggest obstacle to complete andardization of the trucks is the traction motor, both as to its ysical dimensions and the relationship between the axes of the mature shaft and the axle. Due to the restrictions placed upon e builders of locomotives by W. P. B., it was manifestly imssible to make any material progress during the past few years. he sub-committee, however, proposed to have available for mediately after the war a set of standard trucks complete with action motors for 44-ton, 600-hp. and 1,000-hp. switchers. To complish this the sub-committee will co-operate with a comittee on this subject of the A. I. E. E. in an effort to provide suitable standard traction motor which can be used interangeably in all locomotives of the above-mentioned fundamental es.

There are no fundamental differences in the truck arrangements w used on the 44-ton locomotives generally in use, nor on a nsiderable number of the 600- and 1,000-hp. locomotives which ould prevent the complete standardization with interchangeility of all principal parts. In fact, three of the larger manucturers of 600- and 1,000-hp. locomotives now use fundamenlly the same truck with such modifications as are required for e motor-nose suspension brackets and the openings for the action-motor blower ducts. A third large manufacturer uses fferent trucks, but there is sufficient room in the truck now ider consideration to permit installation of this builder's traction otors. It appears, therefore, that there should be no difficulty hatever in designing traction motors with the same general mensions of the case so that motor-nose suspension brackets ill be identical, with identical distance between the center of the mature shaft and the center of the axle, and identical arrangeent of the traction-motor blower duct attachment to the truck ansom.

The standardization of axles for the 600- and 1,000-hp. locomores presents no serious problem and the truck can be so arranged at railroads who so desire can use the special journal boxes id bearings developed by one manufacturer of journal boxes id at present used on a rather considerable number of locomores of these types.

CLASSIFIED REPAIRS FOR DIESEL LOCOMOTIVES

The sub-committee has been requested to outline a system of assified repairs for Diesel locomotives. At the present writing ere seems to be considerable difference of opinion as to the ecessity for classifying Diesel repairs since a number of railads are making such repairs currently on a unit-exchange basis, hanging out traction motors, wheels and axles, complete trucks, s well as complete power plants as the occasion demands and i this way keeping such locomotives out of service the minimum ngth of time. However, for such roads as may desire to classify pairs on this type of motive power, the sub-committee will ttempt to draw up a procedure which can be submitted as ecommended practice.

RATING OF LOCOMOTIVES

In cooperation with the Electrical Section, the sub-committee s attempting to draw up a standardized rating of locomotives of ll types so that a direct comparison of horsepower can be made etween steam, internal-combustion, and electric locomotives. Preliminary meeting of the joint sub-committee has been held ut to date only a rough outline has been prepared of a proposed tandard rating form to cover the various types of locomotives. This, when completed, will be submitted to the appropriate committee of the Electrical Section and the Locomotive Construction Committee for review before it is finally submitted to the member roads.

The sub-committee chairman is A. G. Hoppe, who is assistant chief mechanical officer of the Chicago, Milwaukee, St. Paul & Pacific.

Design of Dry Pipes and Steam Pipes

In 1943 there was submitted to letter ballot for adoption a list of sizes of steel or iron tubing to be used for making dry pipes for steam locomotives. This list, which was approved by letter ballot, included sizes of tubing suitable for dry pipes applied between the throttle and superheater of the locomotive and, therefore, subject to external pressure tending to collapse the pipe. Throttle valves located between the superheater and the cylinders of locomotives are now common. Therefore, an additional list of dry pipe sizes for pipes that are not subject to external pressure is recommended. Recommended changes in page F-6A of the Manual are shown to include these additional sizes. Also included is a 14 in. size in the standard dry pipes for locomotives with pressure.

Dry Pipes and Outside Steam Pipes

RECOMMENDED PRACTICE
ADOPTED 1922; REVISED 1943, 1945

Sizes shown in table below cover recommended sizes of wrought-steel or wrought-iron tubing for dry pipes and outside steam pipes.

Standard dry pipes for locomotives		Dry pipes without pressure	
Outside diameter, in.	Average thickness of wall, in.	Outside diameter, in.	Average thickness of wall, in.
3.5	.200	8	.250
4	.220	9	.250
5	.240	10	.313
6	.280	11	.313
7	.313	12	.313
8	.344	14	.312
9	.375	..	...
10	.438	..	...
11	.500	..	...
12	.500	..	...
14	.500	..	...

Material

Steel ..... A.S.T.M. Specification A-106.
Wrought iron A.S.T.M. Specification A-72 or standing tubing to recognized manufacturers' specification.

The subcommittee chairman is D. H. Kueck, assistant chief mechanical officer, Missouri Pacific.

Globe and Angle Valves for 300 lb. Pressure

During the past year the Committee had some complaint that the design of the hand wheel as shown on page F-171 of the Manual is not entirely satisfactory because the circular shape and smooth contour does not provide a good grip, and is especially slippery when handled with oily gloves.

The Committee is studying the matter, but to afford a remedy in the meantime, it is recommended that the note at the bottom of page F-141 be changed to read as follows:

Note: Hand wheels may be the manufacturer's standard or as specified by the purchaser, provided they properly fit the stem of the standard valve.

The subcommittee chairman is J. E. Ennis, engineering assistant, New York Central System.

Boiler and Firebox Materials and Construction

The 1941 report on locomotive boiler and firebox material and construction showed information obtained by questionnaire to railroads and three builders.

After study of this information, the committee submitted the following recommendations:

ASSEMBLY AND WORKMANSHIP

Boilers should be assembled as free from fabrication strains as possible. This requires that all component parts, particularly the shell courses and connecting sheets be assembled in a workmanlike manner, in order to be free of stresses after riveting is done. Any other procedure will impose unnecessary stresses on parts and contribute to ultimate failure in service and high maintenance costs.

THICKNESS OF TUBE SHEETS

Thickness of tube sheets should be sufficient to provide the required strength without sacrificing necessary flexibility and heat transfer. Heat transfer is, of course, more important for the firebox tube sheet than for front tube sheet, but flexibility is equally important for both. In order to meet the requirements of strength, flexibility and heat transfer, the following thicknesses of tube sheets are recommended:

Front tube sheet to be ½ in. on boilers under 75 in. in diameter and ⅝ in. on boilers over 75 in. in diameter.

Firebox tube sheet to be ½ in. thick for boiler pressures up to and including 300 lb. per sq. in.

The radius of front tube-sheet flange should be not less than 1 in. and not more than 2 in.

The radius of the back tube sheet flange should not be less than ¾ in. with riveted construction and 1¼ in. with welded construction. The minimum space between the side of the tubes and inside of crown sheet should not be less than 2½ in. and space between side of tubes and inside of side sheets should not be less than 1½ in. This distance is based on a ½-in. tube sheet with ¾-in. radius. If these dimensions are increased, the space between the tubes and sheets should be increased accordingly.

It is preferable to hot-flange sheets and they should be annealed to relieve internal stresses and restore the strength of material after flanging.

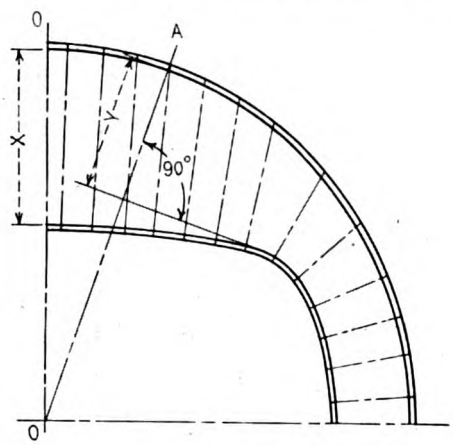
Thickness of Boiler Roof Sheets

Maximum allowable working pressure for any thickness of roof sheet to be computed by the following formula:

$$P = \frac{TS}{FS} \times \frac{tE}{R - \Sigma\ (s \times \sin a)}$$

where:

P = maximum allowable working pressure, lb. per sq. in.
TS = ultimate strength of material, lb. per sq. in.
FS = factor of safety.
t = thickness of roof sheet, in.
E = minimum efficiency of roof sheet through joints or stay holes.
R = radius of roof sheet, in.
a = angle any crown stay makes with vertical axis of boiler.
s = transverse spacing of crown stays in crown sheet, in.
$\Sigma(s \times \sin a)$ = summated value of transverse spacing s × sin a for all crown stays considered in one transverse plane and on one side of vertical axis of boiler.



The above formula applies to the longitudinal center section O-O (Fig. 1) of the roof sheet, and in cases where E is reduced at another section O-A, the maximum allowable working pressure based on the strength at that section may be increased in the proportion that the distance X from the roof sheet to the top of the crown sheet at the center bears to the distance Y, measured on a radial line OA through the other section from the roof sheet to a line tangent to the crown sheet and at right angles to the radial line OA, or

$$P_{max.} = P_{OA} \times \frac{X}{Y}$$

where

P_{OA} = maximum allowable working pressure based on strength at section O-A.

Rate of Increase in Width of Water Space

To provide sufficient space for circulation and release of steam, it is recommended that fireboxes be designed so that the rate of increase in the width of water space will be as follows: (a) adjacent to the firebox tube sheet, not less than .5 in. per ft.; (b) near the firebox door sheet, not less than .3 in. per ft.

Space Between Crown Sheet and Roof Sheet

The capacity of the locomotive boiler is limited by its diameter because this determines the gas area of the flues through which all the gases of combustion must pass; in addition it must provide space for the superheater through which all the steam generated must flow. It determines the flue heating surface that can be installed per unit length of flue, the area of the steam-disengaging surface, and the steam volume above the water level in the boiler. This last item is of the greatest importance, and is, in reality, the limiting factor in high-output operation to prevent water carry-over into the superheater and cylinders.

In order to provide proper area for steam release and volume without unduly restricting boiler capacity, the space between the crown sheet and the roof sheet at the firebox tube sheet should be not less than .30 D nor more than .35 D, where D represents inside diameter, first course.

Threads on Firebox End of Rigid Radial Staybolts

It is recommended that threads on the firebox and of rigid radial staybolts, if tapered, be tapered 1½-in. in 12.

The subcommittee chairman is F. E. Russell, chief mechanical engineer, Southern Pacific.

Report of The Committee on Wheels

Shop inspection discloses conditions requiring extension of mandatory provisions of Section XX of the Wheel and Axle Manual

C. B. Bryant,*
Chairman

In view of the unusual conditions this report is confined to items of unusual importance on those requiring letter ballot or other formal action.

During August, 1944, the committee authorized the manufacture of 150,000 chilled-iron wheels of 750 lb. nominal weight and 50,000 chilled-iron wheels of 850 lb. nominal weight, according to the so-called 1942 design submitted by the Association of Manufacturers of Chilled Car Wheels under date of August 14, 1944. This design incorporates changes in the contour of the flange and in the flange-supporting brackets which should materially reduce flange failures. The design was first cleared with the Track Committee of the Engineering Division. The wheels are to be marked "AAR-X" for identification.

Continuing its study of service behavior of chilled-iron wheels, the committee has arranged to collect data on wheel failures by questionnaires sent to a selected group of railroads. As a consequence of these studies, certain changes in the interchange rules have been recommended which will tend to restrict the use of the single-plate non-bracketed design of wheels. These changes were submitted to the membership in Letter Ballot Circular DV-1087, dated May 21, 1945. The studies are continuing.

The matter of maximum carbon in wrought-steel wheels with reference to question of relationship of high carbon to wheel

* Assistant to vice-president, Southern.

failures has been under study and factual data secured from a selected list of member railroads. This survey indicates the majority of wheel failures on untreated wheels to Specification M-107 are in the upper carbon range. It is recommended that the requirement for carbon content shown under Paragraph 5—Chemical Composition of Section II in Specification M-107 be reduced from the present range of 0.87—0.82 per cent to a range of 0.65—0.77 per cent; also, that Paragraph 8(b) of Section III in the specification be modified by eliminating the underscored portion as shown below:

8(b) When so specified in the purchaser's order, wheels of each type and rough bore diameter shipped in any one carload lot shall be so selected as to permit mating and mounting within a five-point carbon range according to the carbon content stamped on the wheels, *i.e., 67-72, 68-73, 69-74, 70-75, etc., the preferred group ranges being from 70-75 to 75-80.*

These modifications have the concurrence of the Committee on Specifications for Materials.

In order to provide a wheel circumference gauge suitable for use on larger sized wheels, a new gauge covering wheels from 38 to 52 in. in diameter has been authorized subject to letter ballot approval.

An extensive revision of the Wheel and Axle Manual was undertaken during the year and those changes requiring formal approval by the membership have been submitted to letter ballot.

In the annual report dated May 23, 1944, the appointment of a qualified inspector by the association to check wheel-shop practices was suggested. During the intervening year this work has gone forward and the inspection has been effective in disclosing practices requiring improvement. Some of the conditions disclosed have indicated the necessity of strengthening and extending the mandatory requirements of Section XX of the Wheel and Axle Manual, Letter Ballot DV-1087 covers the changes recommended by your committee. These charges will facilitate the improvement of wheel-shop practices.

Material Specifications

Changes proposed in several standard material specifications — Annulments of emergency specifications recommended

T. D. Sedwick,*
Chairman

The committee has given consideration to the annulment of certain emergency specifications as would be desirable and permissible at this time in view of the revocation by the War Production Board of certain schedules of Limitation Order L-211 Consideration has also been given to changes and revisions of certain standard specifications and the following recommendations are submitted:

Carbon-Steel Axles

It is recommended that the annulment of emergency specifications E. M. 101-42, for carbon-steel axles for cars and locomotive tenders in view of W. P. B. revocation of Schedule V to L-211, also the following revisions of standard specifications M-101-41, be submitted to letter ballot.

Revise Sec. 1 (b) as follows: Three grades of axles are provided including: Grade A—as-forged axles up to and including those 6½-in. nominal diameter at the center; Grade B—annealed axles of any size; Grade C—normalized and tempered axles of any size. Freight-car axles over 6½ in. diameter at the center shall be furnished in this grade.

Change "Paragraph" to "Section" in Sec. 13, 14 and 15 (d).

Sec. 20 (b)—If any test specimen fails because of mechanical reasons, it may be discarded and another specimen taken.

Add new Par. (a) in Sec. 22, and move others down from (a) and (b) to (b) and (c):—

Sec. 22 (a) If the results of the physical tests of any test lot do not conform to the requirements specified because a flaw developed in the test specimen during testing, a retest shall be allowed if the defect is not caused by ruptures, cracks, or flakes in the steel.

Sec. 22 (b) present (a)—Change Par. 18 to Sec. 18.

Sec. 22 (c) present (b)—Change Par. 18 to 21 to Sec. 18 to 21.

Sec. 23 (a)—Change the last line to read "dimensions shown in Sec. D of the Manual."

Rewrite Sec. 27 (a) Axles which do not have black collars shall be legibly stamped with letters and figures not less than ¼ in. high, in the location shown in Fig. 6. (b) Axles having black collars may have the same information stamped on the collar with letters and figures not less than ¼ in. high. In this case, the requirement to finish turn one end of the axle for stamping may be disregarded.

Fig. 6 to be revised so as to omit Notes 2 and 5.

Forgings

Specifications have been prepared, embracing in one specification, only, carbon-steel forgings, annealed and unannealed, normalized and tempered, and quenched and tempered, and in another specification alloy-steel forgings, normalized and tempered, and quenched and tempered. These two specifications are intended to replace standard A. A. R. specifications M-102 and M-104, and reference to A. S. T. M. specifications A-236 and A-238 in the association's standards.

(The two recommended specifications are shown as Exhibit *A*, Spec. M-126-45 for carbon-steel forgings and Exhibit *B*, Spec. M-127-45 for alloy-steel forgings. These two exhibits, also Exhibits *C* to *H*, incl., prepared by the committee are not included, for lack of space, in this abstract of the committee's report.—Editor.)

Both of these specifications have been submitted to the Committee on Car Construction and the Committee on Locomotive Construction, and a majority approval was received from both committees. Comments received from one member on each of the committees mentioned have been thoroughly analyzed, and it is felt that the specifications as written are clear as to intent, and that forgings complying with their requirements will be fully satisfactory.

Blooms, Billets and Slabs for Forgings

It is recommended that the question of rescinding Spec. M-105-41 and emergency Spec. E. M. 105-42 for blooms, billets and slabs for forgings be referred to letter ballot of the members. This recommendation is made for the reason that the A. S. T. M. specifications referred to in emergency Spec. E. M. 105-42, have been nullified by that society, and the requirements of our present standard specifications, M-105-41, are such that it is desirable that they be revised to broaden the scope of the specifications, and incorporate additional desirable requirements.

It is, therefore, recommended that, until new A. A. R. specifications can be prepared, with up-to-date requirements, there be shown in the A. A. R. Manual a sheet identified as M-105-45, Exhibit C.

It is recommended that annulment of emergency Spec. E. M. 106-42, for steel tires, locomotive and car, permitted through revocation by W. P. B. of Schedule 11 to L-211, be approved.

Reference to A. S. T. M. Spec. A-53-42 covering furnace-welded, electric-resistance-welded and seamless-steel pipe should be changed to A. S. T. M. Spec. A-53-44.

It is recommended that annulment of emergency Spec. E. M. 112-43 covering carbon-steel bars for railway springs be approved. It is further recommended that standard Spec. M-112-42 be modified by adding requirements shown in emergency Spec. E. M.-112-43, covering flat spring-steel bars, over 6 in. to 8 in. inclusive, to the table in Sec. III.

To bring the requirements of Spec. M-115 for boiler and fire-

* Engineer of tests, Chicago, Rock Island & Pacific.

box, carbon steel up to date, and to include available classes of this grade of steel, the specifications have been revised, and it is recommended that the revised specifications, Exhibit D, be submitted to letter ballot of the members.

The physical requirements of the usual grades have not been changed; however recognized tensile requirements for carbon-silicon steel have been added, and the chemical compositions have also been brought in compliance with present recognized practices.

It is further recommended that annulment of emergency Spec. E. M. 115-43, permitted through revocation, by the W. P. B., of Schedule 8 to L-211, be approved.

It is recommended that the following be submitted to letter ballot of the members: (a) Annulment of emergency Spec. E. M. 116-43, as permitted through revocation, by the W. P. B., of Schedule 8 to L-211: (b) Modification of standard Spec. M-116 covering structural-steel shapes, plates and bars, as follows: Sec. II. Chemical Properties and Tests, Par. 5. Check analyses may be made by the purchaser from finished material representing each melt. The chemical composition thus determined shall not exceed the requirements specified in Par. 3 by more than 25 per cent. The specifications are otherwise to remain the same as now printed.

It is recommended that the following be submitted to Letter Ballot of the Members: (a) Annulment of emergency Spec. E. M. 117-43 covering steel sheets and thin plates, as permitted through revocation, by the W. P. B., of Schedule 8 to L-211: (b) Revision of standard Spec. M-117, as follows: Sect. II. Chemical Properties and Tests, Par. 5, Check analysis—An analysis may be made by the purchaser from finished material representing each melt or lot of ten tons. The carbon, phosphorus, and sulphur content thus determined shall not exceed that specified in Sec. 4 by more than 25 per cent.

It is recommended that annulment of emergency Spec. E. M. 124-42 covering heat-treated tires for cars and locomotives permitted through revocation by the W. P. B. of Schedule 11 to L-211, be approved.

Steel Castings

To bring M-201-36 and emergency Spec. E. M. 201-42 for steel castings up to date, and broaden its scope so as to take advantage of improved present day practices, new specifications have been drafted, and are identified as Exhibit E.

These specifications have been submitted to the Committee on Car Construction and the Committee on Locomotive Construction, and a majority approval was received from both committees. Comments received from one member of each of the committees mentioned have been thoroughly analyzed, and it is felt that the specifications as written are clear as to intent, and that castings furnished in compliance with the requirements of these specifications would be fully satisfactory.

It is recommended that annulment of emergency Spec. E. M. 201-42, and revision of standard Spec. M-201-36 be submitted to letter ballot of the members.

Malleable-Iron Castings

To provide for the use of an alternate test specimen to be permitted under A. A. R. Spec. M-402, for malleable-iron castings, it is recommended that Par. 5 (first sentence) be changed to read as follows: Test Specimens.—(a) Tension test specimens can be of the form and dimensions shown in Fig. 1 or Fig. 1-a. (design of alternate test specimen, attached, identified as Exhibit F, should be shown below Fig. 1 on page 2 of specifications, and designated as Fig. 1-a).

Emergency Spec. E. M. 601-44 for air brake and train air signal hose have been revised to include a cover made of Neoprene rubber. The revised emergency Spec. E. M. 601-45, shown in Exhibit G, are recommended for approval.

It is recommended that specifications for rubber goods, general instructions on standard methods of tests be covered by including in the manual emergency Spec. E. M. 607-45, Exhibit H.

In accordance with practice of reviewing specifications in effect for five years, without change, it is recommended that Spec. M-908-34, covering paper, insulation, for refrigerator cars, be reaffirmed.

As general information, the various laboratories represented in the Committee on Specifications for Materials, are presently carrying out some cooperative investigations of various items, particularly in connection with age resistance tests of synthetic rubber, Buna S and Neoprene, for cover of air-brake hose, brake cylinder lubricants, etc.

Brakes and Brake Equipment

Better control of maintenance of K triples and AB parts provided for—Braking ratios of low gross-to-tare cars revised

J. P. Lantelme,* Chairman

In order to eliminate reports of lubricator swabs coming out of place on AB brake-cylinder pistons, the air-brake manufacturers have improved the design of this lubricator swab by increasing it to double its depth and eliminating the use of the expanding spring.

This change does not effect the interchangeability of any part of the brake-cylinder assembly, nor does it change the price of the piston lubricator.

Maintenance of Freight Air Brakes

A thorough investigation had revealed a number of mechanical variations from standard in the triple valves and test racks, which had an influence on the operation of K valves. Instructions were sent to all concerned calling attention to the importance of inspecting and gauging the various parts of the K valve; also, in order to provide more restrictive tests for the K valve on the test racks, several modifications were made in the Code of Tests (Instruction Pamphlet No. 5039-1) such as: (a) Reducing the maximum allowable resistance in the piston alone and in the piston and slide valve combined; (b) reducing the maximum allowable ring leakage; (c) making the service stability test more restrictive.

These changes were placed in effect September 1, 1944, and if adhered to will result in a reduction of reports of undesired brake applications on freight trains.

Also, to provide more restrictive limitations in the maintenance of the AB valves, the use of the following gauges was recommended, effective September 1, 1944: (a) Gauge for small service and emergency-piston bushings; (b) gauge for the small diameter of the service and emergency pistons; (c) gauge for the diameter of the emergency-piston bush and selecting proper size rings; (d) gauge for the diameter of the service-piston bush and selecting the proper size rings; (e) gauge for the accelerated-release piston; (f) gauge for the vent-valve-piston bush and selecting proper size rings.

Tests of D-22 Valves

Progress is reported in tests of D-22 valves for improved H. S. C. brake equipment on passenger cars and Diesel-electric locomotives. The total number of failures reported to April 30, 1945, on test cars was 104, including failures of the following detail parts: Relay B21, 12; relay F, 10; relay A, 2; D-22 service portions, 11; D-22 emergency portions, 5; slack adjusters, 62; brake cylinders, 11; reservoirs, 1; seals broken, 3. Up to April 30, 1945, 28 cars have been reported for 18-month tests.

From this report it will be noted that while the total number of failures of slack adjusters are highest, it must be remembered that there are four slack adjusters and four brake cylinders to

* General foreman, office mechanical engineer, Pennsylvania.

each car compared with one of any other unit. This is submitted for information and a complete report will be prepared after the three-year period with the committee's recommendations.

Corrosion of Air-Brake Equipment

The committee, in conjunction with the air brake manufacturers, has been making continuous studies since 1939 of various ways and means to reduce or eliminate the corrosion of air-brake parts, especially on refrigerator cars, where in many cases the parts had to be removed before the expiration of the air-brake cleaning date.

In the early stages of the study of corrosion-resistant paints, the manufacturers established that it would be necessary to discard the use of paraffin for treatment of castings. This was for the reason that paints of the type that were found to be best suited for the purpose, could not be used on a paraffined surface. In their research for a substitute for paraffin for treating castings they located a new material that on a thorough trial proved to be superior to paraffin both from a rust-resisting standpoint and a base for paint.

The air brake manufacturers have already changed over to this new treatment for all brake castings.

With the new basic treatment for castings they were then in a position to change over from the present standard paint to a more resistant paint. They have definitely established what materials are required in a paint having high rust-resisting characteristics, and as soon as the materials are available they plan to use them.

In the meantime they have found a substitute paint that tests show to be superior to the paint they are now using, but of course, not as good as the paint they will ultimately use; however, not to defer changing over to the ultimate paint they have decided to use the substitute paint to take advantage of the improvement that can be secured.

The manufacturers advise that this change will not increase the cost of the brake equipment.

Cleaning, Testing and Lubricating AB Brakes

Due to prevailing conditions, including the impossibility of taking cars with experimental AB brakes out of service for test and the increasing number of these cars reported for being inoperative, the reports of which do not give complete information, it was agreed that a letter be sent to member roads requesting that brakes on these cars be given periodic attention. Circular DV-1082, dated February 15, 1945, was issued requesting that these cars be given air-brake attention in accordance with Interchange Rule No. 60, furnishing the additional information shown in the circular. After all these cars have received this air-brake attention, a complete report will be submitted.

Braking Ratios for Tank Cars

Consideration has been given to the braking ratio for tank cars of heavy construction having high lightweights and used to transport the lighter petroleum fractions. In order to include in the present braking power requirements certain classes of cars having an exceptionally low gross-to-tare ratio, it was recommended that a revision of the last two paragraphs on Page E-12 of the A. A. R. Manual, be made as shown below and recommended as a ballot item.

Proposed Form: On and after January 1, *1946*, all freight cars offered in interchange having single-capacity brakes shall have a nominal braking ratio of not less than 50 per cent nor more than 75 per cent of the empty-car weight, based on a brake-cylinder pressure of 50 lb. per sq. in., except refrigerator cars which shall have a nominal braking ratio of not less than 50 nor more than 60 per cent of the empty car weight, based on 50 lb. per sq. in. brake cylinder pressure. Adopted, 1913; Revised, 1938, 1945.

It is also recommended that Par. (b-9) of Interchange Rule 3 be revised accordingly.

In addition to the above, the following items are among those under active consideration by the committee: (a) Test code for single car test device; (b) charging test for AB valves on repair tracks; (c) gauges for AB valves; (d) standard location for release valve handles; (e) automatic blow down for freight-car release valves.

We also wish to record our appreciation for the assistance given by various manufacturing companies on subjects jointly discussed with them, also for the use of their laboratory facilities.

Couplers and Draft Gears

Coupler reclamation practices under close scrutiny —Development of an interlocking type freight coupler is now under way

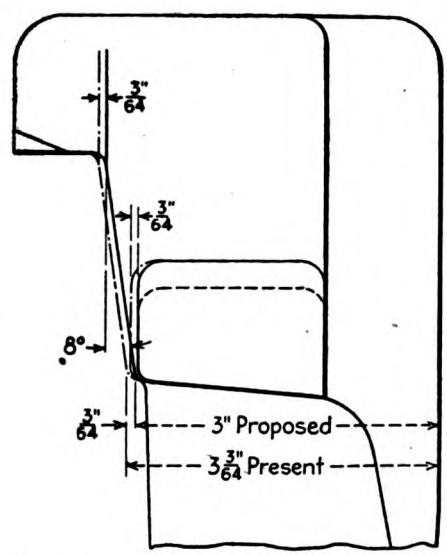
H. W. Coddington,*
Chairman

During the year the committee held two meetings, a portion of each meeting being in conjunction with the Coupler Manufacturers Mechanical Committee that consideration might be given to problems of mutual interest.

One circular letter was directed to the members and private car owners during the year, dated August 10, 1944, relating to the abusive treatment of draft keys resulting from the indiscriminate use of the cutting torch. This letter was accompanied by photographic illustrations of the conditions observed on a member road.

Draft-Key Retainers

It is the opinion of the committee that the inspection of draft-key retainers in transportation yards would be improved if all draft keys were applied from the brake pipe side, since when

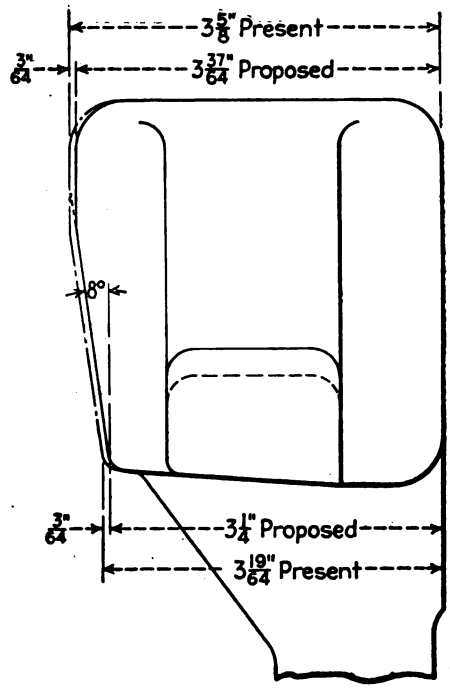


Proposed changes in the thickness of the T-type tightlock coupler lock to permit seating on the knuckle-tail shelf

keys are applied from the opposite side the brake pipe interferes with clear vision of the retainer and the accompanying cotter.

In addition to improving the inspection facilities of the draft key retainer, when keys are applied as suggested, the brake pipe in many instances would serve as a retarding influence should the retainer be missing. Should the key continue to work out

* Research and test engineer, Norfolk & Western.



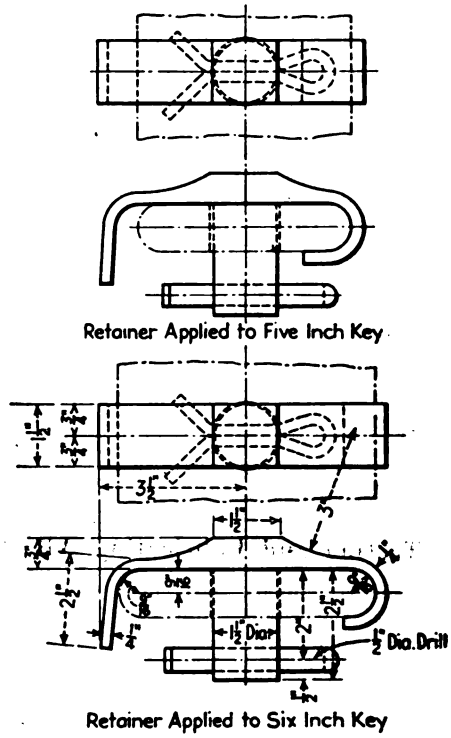
Proposed changes in the thickness of the Type H tightlock coupler lock to permit seating on the knuckle-tail shelf

there is a possibility of fracturing the brake pipe and causing application of the brakes under which condition the defective draft equipment would be detected.

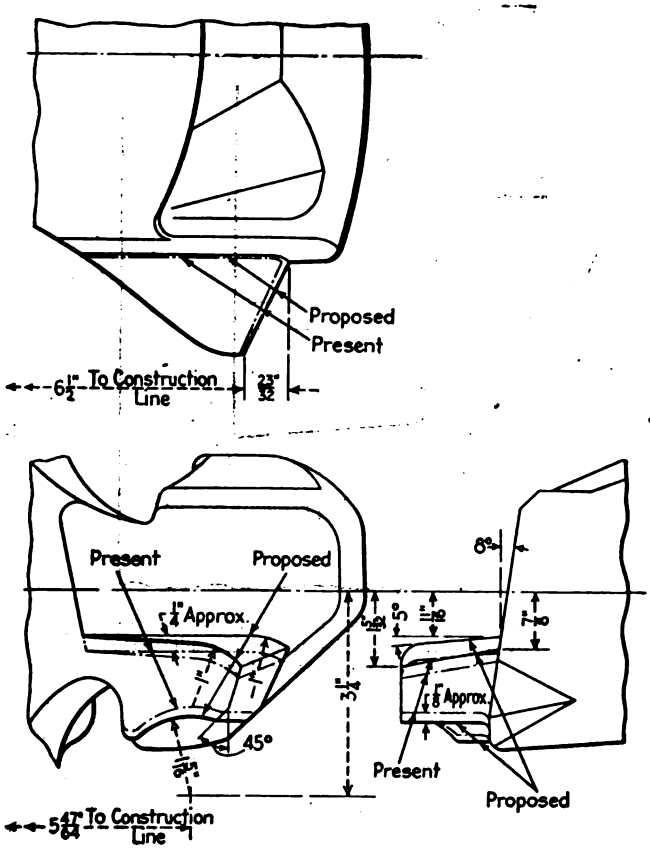
In its meeting in Cleveland on May 3, 1945, the committee was unanimous in recommending to the Committee on Car Construction that draft keys be applied from the brake-pipe side in order to facilitate inspection of the draft-key retainer and cotter.

In the 1944 report mention was made of the appointment of a joint subcommittee of the Car Construction Committee and the Committee on Couplers and Draft Gears to evolve a more secure type of draft-key retainer. Investigation of the loss of retainers due to shearing of the cotter developed that this condition was occurring when the standard retainer would ride up on the shoulder of the outside cheek plates used with two- and three-key draft-gear attachments thus causing a shearing action against the cotter. Recognizing this condition the joint subcommittee presented for consideration a modified retainer in which a steel strap was welded to the top of the retainer head in such a manner that the strap could be bent around and under the edge of the draft key and thus prevent it swiveling into a position where the head would foul on the cheek plate. The Coupler Committee approved this suggested retainer and referred it to the Car Construction Committee.

A further development along this line is the modification of the retainer shown in Fig. 2 of the 1944 report, and consists of a forged retainer with the ends elongated to the extent they can be turned under the draft key to prevent swiveling. This type of retainer also met the approval of the committee and was referred to the Car Construction Committee for its consideration.



A forged draft-gear retainer with elongated ends for turning under the key to prevent swiveling



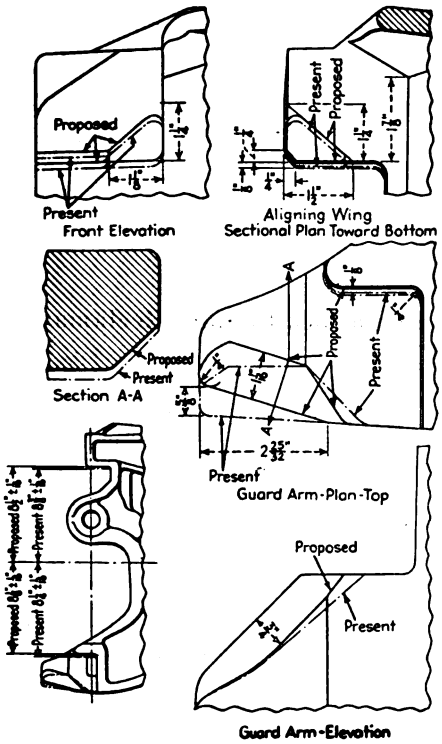
Proposed changes in the lock shelf of the Type H tightlock coupler knuckle to permit seating of the lock

Maintenance and Inspection of Draft Gears

In the early part of 1934, the Director of the Bureau of Safety of the Interstate Commerce Commission, stressed the importance of improving the condition of draft gears and attachments thus reducing the unresisted slack in the coupler and draft-gear assembly. At that time a member road represented on the committee made a check of 1,838 car ends and found that 18.7 per cent of the cars would require attention on the basis of the 1½-in. limit and 38.4 per cent on the 1-in. limit. At that time 1½-in. unresisted slack was set as a limit to be observed when cars were on the shop track and established as recommended practice in 1934 (see Plate L-142-1942 of the Manual of Standard and Recommended Practice).

A similar survey was recently made on the same road involving 3,095 car ends; this survey showed only 3.6 per cent over the 1½-in. limit and 10.4 per cent showed 1 in. free slack.

The committee, in considering this subject, recommends that 1 in. be adopted as recommended practice and Plate L-142-1942 be revised by reducing the present 1½ in. dimension to 1 in.



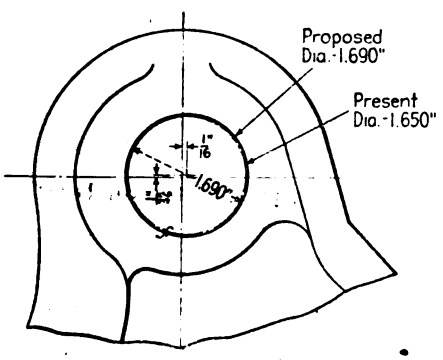
Proposed changes in the guard arm and alignment wing of the Type H tightlock coupler to allow for more guard arm distortion in service

Reclamation of Couplers, Knuckles, Locks, Etc.

During the year two items of reclamation have been presented to your committee for consideration. One was prompted by a report from the A. A. R. mechanical inspectors that they had found instances where parts of separate couplers, the shank of one coupler and the head of another, had been welded together to form a complete unit. While your committee recognizes that such an operation could be satisfactorily performed if properly supervised, it does not consider that a practice of this kind should be recognized or permitted under the Association's rules governing the reclamation of couplers and parts.

Another suggestion has been made that couplers be normalized at the time cars are undergoing heavy repairs.

The process of normalizing would be of value in overcoming a



Proposed change in the diameter of the pivot-pin hole in the pivot lugs of the Type H tightlock coupler

condition of metal fatigue, but examination of broken couplers does not indicate that any appreciable proportion of these failures can be attributed to metal fatigue. Taking into consideration the fact that the coupler would have to be completely dismantled for the normalizing treatment due to the difference in composition of parts, and the questionable value that might be obtained from a general practice of this nature, the committee does not look with favor upon recognizing this as a suitable procedure to improve the shock resistance of the coupler.

Proposed Articulated Rotary Lever Assembly

A subcommittee of the Mechanical Committee of the Standard Coupler Manufacturers has been following the performance of the proposed articulated rotary lever assembly as applied to Atchison, Topeka & Santa Fe cars, but limited observations did not warrant a report of progress at this time.

The subcommittee has earnestly requested that members of the Coupler Committee apply from 25 to 50 car sets of this operating arrangement until some 200 additional applications are made so that the operation of the device can be observed under more extensive and diversified service conditions.

At its meeting in Cleveland on May 3, 1945, the Coupler Committee authorized these additional applications with the understanding that the Mechanicl Committee would make the necessary arrangements directly with the railroads they may select and report the name of the railroad and the car number to A. C. Browning as the application on each road is completed.

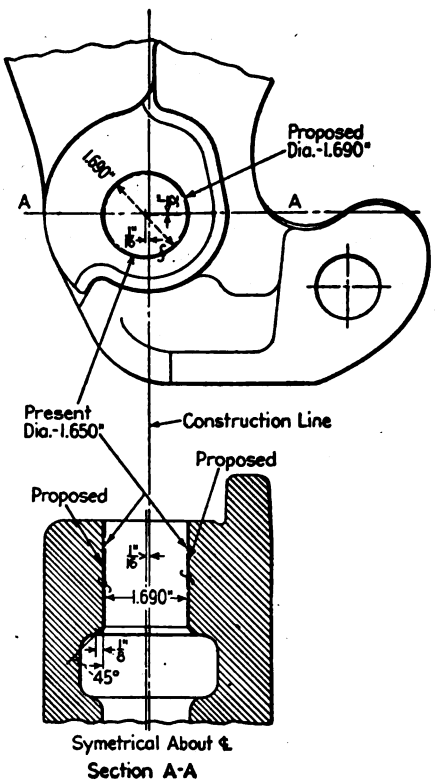
Increased Yield Strength of Knuckles

The Mechanical Committee of the Standard Coupler Manufacturers has for some time been investigating the possibility of increasing the yield strength of knuckles for standard Type-E and tightlock couplers in order to reduce the stretching and breakage of knuckles occurring in service.

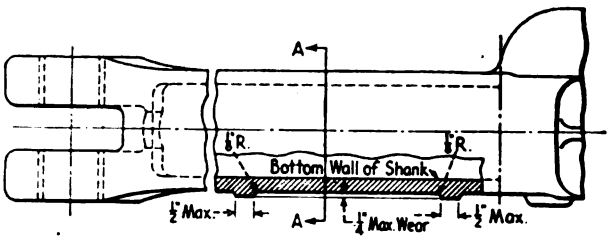
An important part of this problem is to keep the ultimate strength of the knuckle less than the ultimate strength of the bar as a protection against breakage of the bar. The development work has progressed to where the desired results have been obtained experimentally and a program of tests has been laid out and approved. The required material for these official tests is now in process and when available, arrangements will be made to conduct the tests under the supervision of the joint subcommittee representing both the Mechanical Committee and the Coupler Committee having in mind that when this program is completed suitable specifications will be developed.

Tightlock Couplers

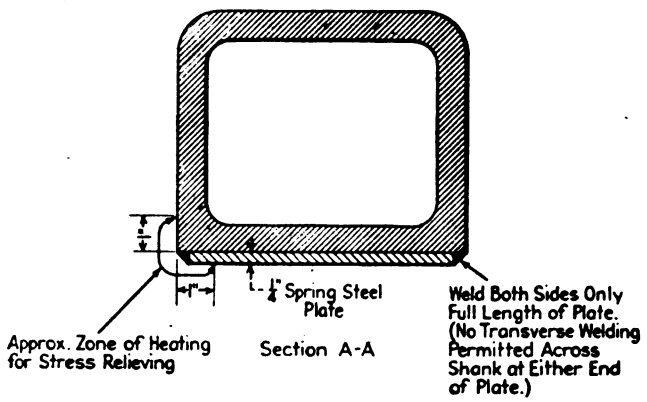
During the past year the problem of sticking locks in tightlock couplers has been carefully investigated. Service experience has demonstrated that when the lock becomes seated on the shelf of the knuckle tail, sticking of the lock no longer occurs. The



The proposed change in diameter of the pivot-pin hole of Type H and T-type tightlock coupler knuckles



1. Shanks Worn from Contact with Carrier not in Excess of Amount Shown may be Restored by Machine Finishing Surface to Depth of ¼" and Welding in Place Spring Steel Wear Plate as Shown in Section A-A.
2. Welding shall be Performed by the Electric Process, Using Shielded Arc Electrode.
3. After Welding the Coupler Shank shall be Stress Relieved in the Vicinity of the Weld as in Section A-A at a Temperature of 400°C. (750°F) to 500°C (930°F) FAINT RED COLOR.
4. This Method of Reclamation is Approved Only when All Stipulated Requirements are Observed.



Method of reclaiming tightlock coupler shanks when worn from contact with the carrier

Mechanical Committee of the Standard Coupler Manufacturers recommends that when objectionable sticking of locks occurs in service, adjustments be made by reducing the thickness of the lock by machining or grinding the knuckle face of the lock an amount sufficient to lower the lock until it seats on the knuckle-tail shelf. The amount to be removed from the knuckle face of the lock depends upon the distance the lock seats above the knuckle tail shelf, the ratio being 1/64 in. for each 1/8 in. the lock is above the shelf.

The Mechanical Committee also recommended for new Type-H couplers, changes in the thickness of the lock and the height of the shelf on the tail of the knuckle to provide for seating of the lock on the knuckle-tail shelf or not to exceed 1/8 in. above the shelf. These changes were approved by the Coupler Committee with the understanding that the coupler manufacturers will continue to consider other possible means to eliminate sticking of locks and still retain the take-up slack feature This approval also included a reduction in the thickness of locks as manufactured for maintenance of T-type tightlock couplers modified in accordance with Circular No. 942-A.

Another improvement affecting the tightlock coupler was recently recommended by the Mechanical Committee and has been approved by the Coupler Committee. This change involves an increase in the diameter of the pivot pin hole in the pivot lugs of the Type-H coupler head, the Type-H knuckle and the T-type knuckle. Service experience has shown that the previous diameter of the pin hole was too small to accommodate satisfactorily the standard knuckle pin and to provide for proper fitting between the pulling lugs and buffing shoulders of the coupler head and knuckle.

An improvement has been made affecting the interlock between the guard arm and gathering wing pocket to assure more satisfactory coupling between two type-H couplers even though the end of the guard arm of either or both couplers has been bent outward as much as 3/4 in.

All type-H couplers, knuckles and locks as well as knuckles and locks for maintenance to T-type modified couplers bearing cast date May, 1945, and later, will incorporate all the above improvements.

In February, 1943, the Committee on Couplers and Draft Gears and the General Committee approved the modification of existing T-type tightlock couplers in accordance with Mechanical Committee Circular No. 942-A, which provides for changing to rotary operation, using the No. 6 coupler operating mechanism and incorporating the same principle of anti-creep arrangement as employed in the type-H coupler. With few exceptions, the railroads using tightlock couplers have initiated a modification program and have a considerable number of these couplers modified. The coupler manufacturers have improved conditions so that they are now in better position to supply the needed coupler and operating mechanism parts to keep these modification programs moving.

Tightlock-Coupler Reclamation

A satisfactory method of reclaiming tightlock coupler shanks where they have been worn from contact with the carrier has been under consideration by the Mechanical Committee and the Coupler Committee. At the last joint meeting a reclamation practice was approved which consists of smooth machine finishing of the worn surface of the shank to a depth of 1/4 in. and welding into the recess thus formed a 1/4-in. spring-steel plate. This reclamation procedure will be issued in the form of a circular for general distribution.

The Mechanical Committee is now preparing a new circular which will cover all recommended tightlock coupler reclamation practices, including that here described. It is intended to include also in this circular a complete guide to the proper maintenance of tightlock couplers. This circular when completed will be made available to all concerned.

Proposed Type-F Interlocking Freight Coupler

The subject of developing a postwar interlocking coupler for freight equipment is being progressed as rapidly as possible. A joint subcommittee has been appointed to represent the Car Construction Committee, the Mechanical Committee of the Standard Coupler Manufacturers and the Committee on Couplers and Draft Gears. Several meetings have been held and definite progress has been made. As soon as a satisfactory design is agreed upon by the joint subcommittee, this design, together with a schedule of laboratory and road service tests, will be referred to this committee for consideration and appropriate action.

Tightlock Yoke for Use with Twin Cushion Draft Gear

A member road has suggested a design of short coupler yoke for use with Twin-Cushion draft gears which can be applied to a car with the standard A. A. R. 24 5/8 in. length draft gear pocket. This design has been considered jointly with the Mechanical Committee of the Standard Coupler Manufacturers and plans are now under way for making necessary laboratory tests to develop principally the column strength of the yoke under buff. This matter is being progressed as rapidly as existing conditions will permit, and appears to the committee as being a desirable design pending the results of the laboratory tests.

Report of Subcommittee on Draft Gears

There has been no change during the past year in the number of approved draft gears. The list of approved and conditionally approved gears will be found in A. A. R. Circular N. V. 1067, page 11, and also in the latest copy of the Interchange Rules under Rule 101.

During the past year authority has been granted for the application of 2,500 additional car sets of the gear, which is designated as Waugh Twin-Cushion Type WM 4-6. By this action the total applications authorized to date amount to 3,900 car sets.

Emergency Substitutions of Materials

The subcommittee has recently obtained specific information from the various manufacturers covering physical properties of substitute materials which are being used in certain certified gears during the present emergency because of government restrictions on the use of critical materials. In most instances the manufacturer proposes to return to the use of original materials as soon as they are again available and the subcommittee

will require this in all cases unless it can be shown that the substitute materials are as good as or better than those originally specified.

Draft Gears Manufactured in Canada

As promised in last year's report, specimens of all certified gears manufactured in Canada were selected at random from railroad or car builders stocks by representatives of the subcommittee and shipped to the Association Laboratory at Purdue University for check tests. These tests have been in progress since last summer and should be completed soon, after which the results will be reported in due course. It may be stated at this time, however, that certain deficiencies have already been called to the attention of the manufacturers involved with the suggestion that prompt corrective action be taken. In each case these manufacturers have shown a disposition to cooperate willingly.

Eighteen Applications Requesting Approval of Tank-Car Appurtenances

Applications	Tank-car appurtenances
1—	Tanks fabricated of aluminum
1—	Protective housing for manway cover fittings
1—	Safety valve assembly for anhydrous hydrofluoric acid tank cars
1—	Ton-containers of fusion-welded construction
3—	Fusible plugs for ton-containers
1—	Angle valves for liquefied petroleum gas tank cars
1—	Gaging device for liquefied petroleum gas tank cars
1—	Arrangement for sealing off heater systems
1—	Modification of retest requirements for sulphuric acid tank cars
1—	8-in. bottom outlet arrangement
1—	Substitute materials for Class I.C.C.-105-A series tank car manway cover studs and bolts
1—	Procedure for reconditioning ton-containers
2—	Revision of Fig. 8—Manhole covers for I.C.C.-104-A type and I.C.C.-105-A type tank cars
1—	Method of securing safety appliances
1—	Stuffing-box design for bottom outlet valve operating rods extending through dome

Report on Tank Cars

Work of the committee was kept up without a formal meeting but members were called upon to serve on sub-committees

F. Zeleny,*
Chairman

Since the last report, 232 dockets and applications for approval of designs have been submitted as follows: 87 covered designs, materials, and construction of 1,967 new shipping containers, for mounting on new cars or for replacement on existing cars; one application covered the construction of eight multiple-unit cars to be used for the transportation of 15 Class I. C. C.-106A-500 one-ton containers each; 126 applications covered alterations in, additions to, or conversions and reconditioning of 2,165 existing tank cars or shipping containers.

No reports have been received to indicate that any difficulties have been had in the continued use of B. & O. box car 390000, equipped with four steel-lined wooden tanks; B. & O. box car 390050, equipped with five corrugated-steel tanks; and 100 car sets of converted air-activated cement containers, in the transportation of authorized less-dangerous petroleum products.

Modifications of I. C. C. Regulations

Upon request of the Office of Defense Transportation, the committee and the Bureau of Explosives recommended to the Interstate Commerce Commission a modification of the latter's regulations to authorize the use of Class A. R. A.-IV and I. C. C.-104 tank cars converted and stenciled as provided in Sec. 303 (q) (1) for additional service transporting, inflammable liquids, under requirements suggested. The commission adopted the recommendation making it effective by suitable order.

Upon recommendation of the committee, the commission by appropriate order authorized the use of Class A. R. A.-IV and I. C. C.-104 cars lacking specification expansion domes, which had required renewal but were not replaced because of inability to secure materials promptly and of the urgent necessity for prompt return of cars to service, transporting 65 lb. liquefied compressed gas. The order required any such modified cars to have their specification markings supplemented by the term, "Emergency."

To meet an extreme emergency in the production of ordnance and aviation gasoline because of lack of sulphuric acid at certain plants producing the former, the Office of Defense Transporta-

* Engineer of tests, Chicago, Burlington & Quincy.

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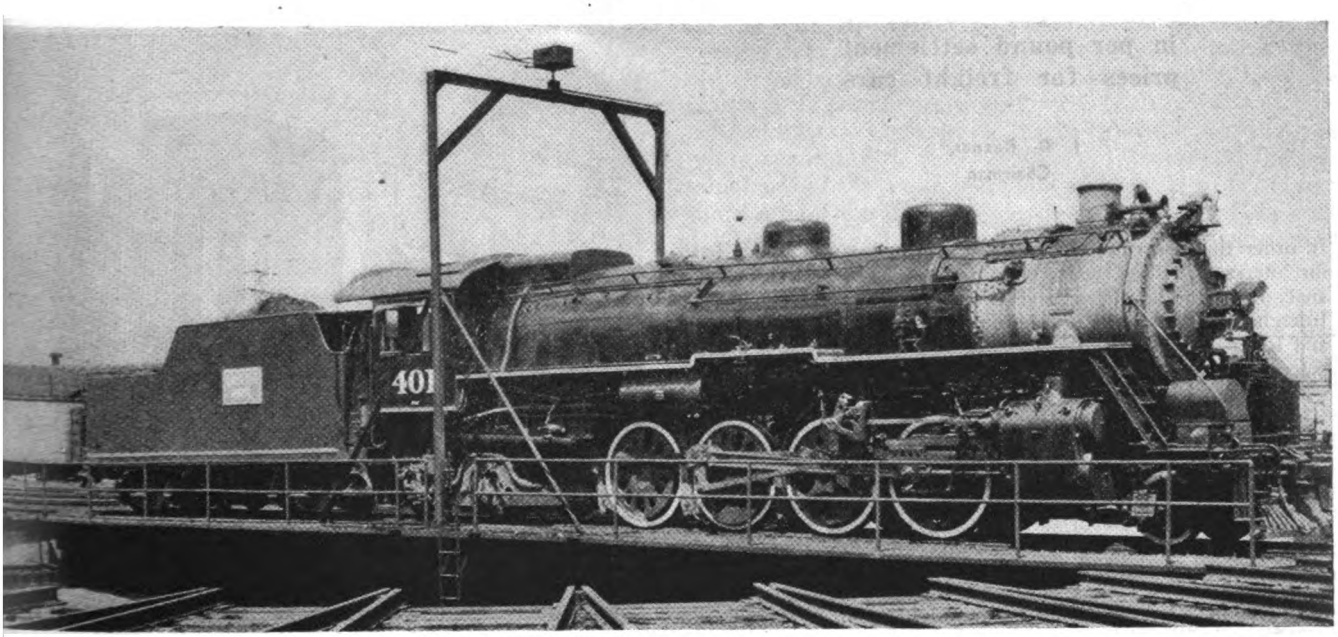

Green Bay & Western Locomotive 401 is one of six 2-8-2 type locomotives which are averaging 9,000 miles a month in freight service between Kewaunee, Wis., and Winona, Minn.

Proposed Alterations, Additions or Conversions Affecting 2,165 Cars or Shipping Containers

Alter for additional lading service
Anchorage changed from cast steel set-in type to single-piece riveted type
Bottom outlet removed
Conversion from A.R.A.-III general service to A.R.A.-III acid service
Conversion from A.R.A.-IV to A.R.A.-IV modified for 65 lb. liquefied petroleum gas (Iso-Butane) service
Conversion from I.C.C.-103 to I.C.C.-103 insulated
Conversion from I.C.C.-103 to I.C.C.-103-B
Conversion from I.C.C.-103-A to I.C.C.-103-A insulated
Conversion from I.C.C.-104 to I.C.C.-104 modified for 65 lb. liquefied petroleum gas (Iso-Butane) service
Gaging device and protective housing installed.
Heater systems installed
Heater systems removed
Insulation and jacket installed
One-ton shipping containers reconditioned
Overhead unloading arrangement installed
Tank capacity increased
Tank lining installed

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tion requested permission to use inflammable liquids cars in limited number, restricted service, and for a definite period to transport acid from its point of production, for not to exceed 25 miles, to the gasoline producing plants. The committee's recommendations for modification of the commission's regulations, concurred in by the Bureau of Explosives, to relieve the situation and authorize the use of readily available equipment without the necessity for its shopping and alteration, were made effective by the commission's order, dated January 25, 1945.

Upon recommendation of the committee and the Bureau of Explosives, the commission by its order of January 25, 1945, authorized the use of frangible discs having a ⅛-in. breather hole in the center thereof to be applied to safety vents of Spec. ICC-103-A tank cars assigned to the transportation of sulphuric acid, as specified, in order to promote safety.

While the committee as a whole has held no meetings since its last report on May 23, 1944, its members have frequently been called upon to serve on numerous subcommittees. These members' reports have been extremely helpful to the committee in disposing by correspondence of the various proposals, applications and dockets requiring its attention.

Committee on Prices for Labor and Materials

Prices of materials show slight increases requiring rule changes—No change in per pound settlement prices for freight cars

J. D. Rezner,*
Chairman

In order that the rules may currently provide an equitable basis for inter-road billing, your committee has continued the work of analyzing material, labor and new equipment costs in A.A.R. Interchange Rules 101, 107, 111 and 112 of the Freight Car Code, and Rules 21 and 22 of the Passenger Car Code, with a view of determining and recommending necessary changes to be made in the next supplement to the current code.

Rule 101

All miscellaneous material prices in Rule 101 were rechecked as of March 1, 1945, quotations submitted by the purchasing agents of the 10 selected railroads, representing 39 per cent of total freight car ownership in the United States and Canada, showing a slight upward trend in material markets as indicated by detail recommendations for revisions shown under this rule.

New Item 107-C is added to provide charge and credit for A.A.R. approved types of geared hand brakes.

Revised identification table for brake beams as recommended by the Committee on Car Construction, which eliminates obsolete types of beams, is substituted for present Fig. 1 (page 205 of the 1945 code of interchange rules). References thereto in Notes 2 and 4 following Item 213 have been modified accordingly.

The item "Brake Wheel" in table of weights of miscellaneous items on page 210 of the current Code, is modified to indicate that wheels for geared hand brakes are not included.

Rule 107

Item 41 is eliminated and the wording of Item 98 modified to provide that R. & R. or R. of center pin is included in the allowances prescribed therein which is considered ample to absorb the go-get expense involved.

Item 114 is modified to eliminate conflict with Item 81.

Rule 112

No tank cars of classes 103, 103-A and 203 were built during 1944 and other types of freight cars constructed were considerably below the quantities on which per pound settlement prices have been established in the past. For this reason and because the cars were mostly built in small lots under prevailing emergency conditions with wide fluctuations in costs and also because material quotations during 1944 reflected only slight changes over the two preceding years, no change in per pound settlement prices for freight cars is recommended.

Passenger Car Rule 21

Item 20-K (slack adjusters) is modified to include necessary repair work and the allowance is increased accordingly.

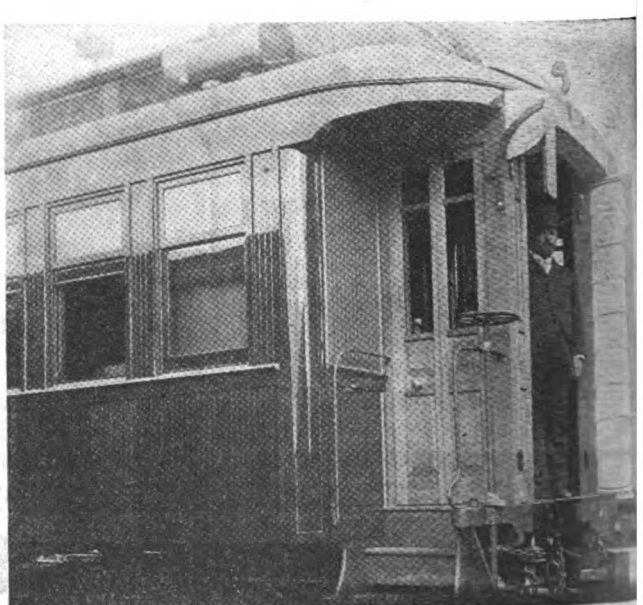
Passenger Car Rule 22

Material price quotations were rechecked on the basis of quotations as of March 1, 1945, showing a slight upward trend, as indicated by detail recommendations for revisions shown under this rule, with the exception of service metal on wrought-steel wheels which reflects a slight decrease brought about by increase in scrap prices.

New Items 38-A, 39-A, 40-A, 41-A and 42-E are added to provide allowances for 2½-in. steam train line parts and appurtenances, and Note 1 under Item 41 is modified accordingly.

It is the intent of the Committee to investigate material costs again in October and if sufficient change develops, necessary revision will be made and inserted in the Rules effective January 1, 1946.

* * *



Application of early type of Barr narrow vestibule to a Milwaukee coach (October 5, 1889)—J. N. Barr, superintendent of motive power, stands in the doorway

A VACATION FOR ED*

No, suh! You done fixed it too good and it won't quit

By
Walt Wyre

THE big boss called Ed, the electrical editor, into the office and said, "Ed, you didn't have a vacation last year, if I remember correctly, and I've been thinking we might possibly arrange for you to get away a couple of weeks this summer."

"Thanks," Ed said. "That would be nice. I sure would appreciate a vacation. I might even pick up a little magazine material at the same time."

"Glad you mentioned magazine material," the boss said. "Of course you'll arrange material for the issue while you're away. Where do you plan to go on your vacation?"

"Oh, I hadn't planned much," Ed said. "If it wasn't so far, I'd like to go to Colorado. Walt Wyre, you know, the fellow that does stories for us about Ned Sparks and Jim Evans, has a place in Colorado. He's invited me to come out there."

"Yes, I've read some of the Walt Wyre stories," the boss said noncommittally. "It might be arranged so you could have time to go to Walt's place. I understand it's not too far from Denver."

"That sure would be fine." Ed beamed and no one can do a better job of beaming than Ed, the electrical editor, when he is pleased.

"Well, that's settled," the big boss picked up a notebook. "I presume you had planned to go by way of Chicago and Kansas City."

"Hadn't figured any particular route; in fact, I didn't know I would get to go anywhere," Ed reminded.

"That's as good route as any. Now while you're in Chicago, get in touch with Peters in our Chicago office and arrange to get a story at the Diesel electric plant at La Grange. While you're there it won't take long to run over to the Illinois Central and get something on their maintenance of electrified suburban trains. Spend a day or two in Chicago. We can use some good electrical material," the big boss suggested pointedly.

"O. K., I'll do that and thanks for the vacation." Ed rose and started to leave the office.

"Just a minute. There's been quite a bit of discussion about using higher voltage for train lighting and air conditioning, I understand. Might be a good idea to contact electrical men and get their ideas on the subject."

"That's right," Ed agreed. "Air conditioning has increased power demand considerably, making it necessary to use heavier wiring and batteries. Some electrical engineers are advocating 64-volt systems, some recommend 110 volts, others think 110/220-volt three-wire systems would be better and there are some who for various reasons do not advocate changing from the present 32 volt systems, which are most used."

"Well, get some material on the subject, not just opinions, but get facts and figures."

"I'll see what I can do," Ed fidgeted uncomfortably. Getting data complete enough to be of authoritative value on the subject of train voltages would require a lot more than a little casual questioning.

"Anyway, it's something to be working on and you might spend a little time in Kansas City around the terminal and at the waste reclaiming plant. It's over across the river on the Kansas side, I understand. That's all, I guess. You can figure on leaving about August first and you can take fifteen days."

ED SWALLOWED the groan that formed in his throat. Fifteen days! Eight days traveling, three days in Chicago, two days in Kansas City would allow just two days of actual vacation time. The beam on his face became a frown as he rose and left the office. Instead of at least ten days of fishing and loafing in the crisp mountain air as he had envisioned, prospects had faded to a long hard trip, maybe a night's rest and starting back.

Well, two days was better than none. Besides, it would be an opportunity to see a lot of new country and maybe find a good place to vacation later on.

Between getting ready for the vacation and working up material for the magazine, Ed was busy as an ant at a picnic for the next ten days. His fishing tackle had not

* In this story Walt Wyre turns his imagination on the editor to produce a mid-summer fantasy. When he writes about railroads he is sure of his facts.

been used for two years and some of it had been mislaid. His fly reel, the one that worked, had been loaned to an electrician the summer before and the electrician had neglected to return it. He found his fly rod, a book of flies, and a mess of hooks, then the tip joint of his fly rod fell on the floor and he stepped on it and broke it. Maybe Walt would have an extra tip, he figured, and packed the rod anyway.

By only wasting five or six hours out of each twenty-four for the next ten days, Ed managed to get everything in pretty fair shape for the next issue of the magazine and his things packed for the trip. A broad hint not too lightly dropped and the boss told Ed to go ahead and start on his vacation three days sooner than originally planned. He called the passenger station and asked about getting a lower berth to Chicago.

"About two weeks after Labor Day," the agent said. "Business usually falls off a little about then. I might let you have an upper on one of the slower trains."

"O. K., if that's the best you can do. What time can I leave?"

"Let's see," the agent said, "I can give you an upper on a tourist car leaving here at 6:15 tomorrow morning."

"I'll take it," Ed said resignedly.

At the station Ed ran into Bill Johnson, assistant electrical engineer for the railroad. Bill suggested a cup of coffee and a doughnut. "The train hasn't been called yet," Bill said.

The two men pushed through the crowd and finally found places in the coffee shop. A very disinterested waitress served them doughnuts that from their appearance and taste might have started out as synthetic rubber experiments with coffee that made them wonder if it came out of the coffee urn or kitchen sink.

In the meantime the train had backed into the station. Bill led the way through a side gate and the two got in ahead of the crowd. Bill knew the Pullman conductor and introduced him to Ed. "Take good care of him," Bill told the conductor. "Ed's a friend of mine."

After about two hours riding, Johnson said goodby to Ed and left the train. Ed, a short time later, started to the diner to get lunch, but started was all, the diner was full and a line of people extending well into the adjoining Pullman made prospects for lunching soon very slim. About thirty minutes later he went back. There was still a line, but shorter, and he waited. About twenty minutes later Ed reached the door. "Sorry," the steward said, "but the diner will be closed until dinner time."

On the way back to his seat, Ed met the Pullman conductor, who said, "Say, aren't you an electrician?"

"Well, I might be called an electrician," Ed grinned. "I've worked at the trade."

"Well, there's something wrong with the lights in the next car back. If it wouldn't be asking too much for you to look at it——"

"I'll look at it," Ed agreed, "but I don't have any tools with me."

"The porter has a screwdriver and some pliers," the conductor said.

A blown fuse was the trouble in the car. When Ed put in a new fuse link, the lights were O. K.

"Thanks a lot," the Pullman conductor said. "First time I see you in town, I'll buy you a drink."

"If you'll just tell me how to get a sandwich and a cup of coffee now I'll call it square," Ed replied.

"Oh, that can be arranged. I'll have the porter get you something."

"Fine," Ed beamed, "if you have any more electrical trouble, just let me know."

He got the sandwich and coffee O. K., but it wasn't long until he regretted his rash promise to take care of electrical trouble. The air conditioning in another Pullman quit and the conductor very tactfully reminded Ed that a man of his electrical knowledge and ability might be able to get it going in just a few minutes.

Evidently there was something wrong with the thermostat circuit or relay because after checking all fuses, Ed short-circuited the test points and the apparatus started working. "When the car gets cool enough, better turn the air conditioning switch off," Ed told the conductor, "then when it begins to warm up, turn it on again."

"O. K., I'll tell the porter."

The smoking room was crowded and there was no lounge car. The porter started making up berths early and there being no place to sit, Ed climbed upstairs and to bed. He was dreaming of having a tug-of-war with a monstrous trout when he awoke, but it wasn't a fish doing the tugging, it as the Pullman porter.

"What's the trouble?" Ed asked sleepily.

"Sho' hates to wake you, Cap'n, but that air conditioning you worked on up the car ahead——" the porter said.

"Yes, what's the matter with it? Has it quit again?"

"No, suh, dat's jes' de trubble. You done fixed it too good, an' it won't quit. I'se dug out all de extry blankets in de car an' de people is hollerin' for mo' blankets."

"Did you turn it off?" Ed asked.

"No, suh, it's jes' like you left it."

"O. K., I'll show you how to turn it off." Ed looked at his watch—2:30 a.m. He climbed down and went to the Pullman. When he entered it felt like entering a frozen food locker plant. Ed turned the air conditioning off and explained to the porter about controlling the air conditioning with the switch, then went back to bed.

Next morning he was awakened by the noise in the crowded Pullman and trading his morning shave for a place in line managed to get breakfast.

That evening when he reached Chicago, he found that Peters had reserved a room for him. It was too late to go to the I. C. terminal or out to the Diesel-electric plant. Next morning he met Peters at the office and they arranged to go to the Diesel plant that afternoon. The assistant superintendent, very young and very cordial, insisted on going into minute details of every operation to such an extent that Ed was forced to go back next day to get the complete story. That afternoon he went to the I. C. and was more fortunate. He got the story there in short order.

Ed was planning to leave Chicago for Kansas City that night but when he went by the magazine office Woodward handed him a wire from the big boss.

"Get story of special tools and equipment used to expedite locomotive repairs at Silvis."

Ed groaned as he saw another day vanish.

At the Kansas City passenger terminal Pearson was very helpful and he got the story in short order and still had time to catch an Argentine street car across the river. As he rode along above the acres of stock yards, Ed noticed that not many of the pens were filled with cattle, but the odor was strong enough to have come from the Augean stables before Hercules flushed them out. On by the soap factories, down by mule barns and boiler works the street car clanked and groaned until the tracks straightened out in Kansas City, Kansas.

It is about half a mile from the street car line to the shops where the "dope" reclaiming plant is located. Ed walked because there was no other means of getting there available. He got the story and rushed back to town and, too late, remembered he had no hotel reservation. He took a taxi to the station. The taxi driver was a girl

and she gave Ed a ride he'll not forget for a long time. She drove with reckless abandon as though all lights were green and no other cars or trucks on the streets. He called all the larger hotels first and received the same answer from each of them, "Sorry, nothing left." He finally got a taxi and went hotel hunting. At last he found a room in a place courteously called a hotel. He had a room on the second floor over a pool room evidently operated for the benefit of swing shifters. They played a little and talked a lot until almost daylight.

NEXT morning Ed went to the telegraph office. There was, as he had feared, a wire from the boss. "Are you getting material on car voltages," the message read. He tucked the message in his pocket and went to the passenger station. There he was fortunate and obtained reservation on the streamlined train to Denver.

The crisp cool morning air in Denver felt good and for the first time Ed felt as though he was actually on vacation. Luck was still with him and he found a nice room with a bath. After he had cleaned up a bit he called a taxi and went out to the Pullman yards. There he found a gang of the most versatile mechanics he had seen for some time. While Ed was talking to the foreman, he saw two men working on troop sleepers and kitchen cars. They changed out a set of batteries, the long life, non-rechargeable kind developed since the war started, put a new grate in a range, repaired the water system, fixed a broken bunk in a sleeper, repaired a faucet, then left to change a generator on a standard Pullman.

The foreman and Ed walked down by the string of cars that were being made ready for service, the foreman explaining how the cars were routed to reach a repair point as they needed servicing. When the foreman and editor returned the mechanics had the generator in place and were applying a new belt. Ed observed with interest the method used for getting the proper belt length. The generator was pulled up with a small rope block, then the belt was passed around the pulley rim, measured and cut. When the belt fasteners were riveted the belt slipped easily into place on the pulley, then when the blocks were loosened the belt had just the proper tension.

"Well, if you've seen all you care to see here, you might like to go over to the Burlington shops," the foreman said. "If you like, I'll take you over."

"Thanks," Ed said, "I'll be delighted."

Next morning Walt Wyre met Ed in Denver. After exchanging greetings, Walt said, "Hope you won't mind riding in a truck. I needed some things for my place and the tires on my car are so thin I was afraid to drive it."

"Not at all," Ed said, "riding in a cab of a truck should give me a good view of the scenery as we go along."

"You'll get a good view of the scenery, all right," Walt told him. "If we get started right away we might make my place by good dark."

The two men went to Ed's room and there sticking in the edge of the door was a well-known yellow envelope. The message was from the boss. "See Ray McBrian, might get some good material for magazine. Also see Whipple about Diesels working with steam locomotive helpers."

Ed groaned and called a taxi. "I'd advise walking if you are in a hurry," Walt said, "or else take a street car. The car line runs within about four blocks of the shops."

Ed had just about decided to either walk or take a street car when the taxi arrived. There were already three passengers in the cab to be distributed enroute. Ed saw quite a bit of Denver before the cab headed down Santa Fe Drive on the way to the shops.

It was almost three o'clock in the afternoon before Ed returned to the hotel. "Well, I guess we are ready to start," he told Walt. "Where is the truck?"

"In a parking lot about six blocks away," Walt replied. "You get your baggage while I get the truck and drive by to pick you up."

WHEN Ed saw the truck he understood what Walt had meant about being able to see out. The view was entirely unobstructed—no cab or top to spoil the view.

"Have you got an overcoat with you?" Walt asked. "It'll be pretty cold going over the mountain after the sun goes down."

"No, but I've got a heavy shirt and sweater," Ed told him.

"Well, you'd better dig them out."

About two hours after they left Denver they were well into the mountains. The old model truck Walt was driving coughed and rattled along. Ed thought every minute it would shed one of its flapping fenders, lose the radiator, the engine fall out of the frame, or all fall apart at once, but somehow it kept chugging along until Walt stopped to put water in the radiator. "Hold your foot on the brake," Walt cautioned Ed.

The road appeared practically level to Ed but when he eased up on the brake the truck started to roll backwards. "Look back and you'll get an idea how steep it is," Walt told him.

Ed looked and saw the road they had just come over several hundred feet below.

They reached the summit of the Divide just at dark; Ed wrapped in heavy shirt and sweater, was shivering with cold and stayed cold until they reached Walt's shack in the mountains.

"I'll warm the coffee and heat up a pot of beans," Walt told him when they entered the cabin. "Got a match? I'll light the lantern, then build a fire."

The brush burner stove soon was roaring and Ed thawed out and after a cup of warmed-over coffee, a plate of ditto beans, and some slightly stale bread, Ed was ready for bed.

"You sleep over there." Walt pointed to a bunk made of pine poles with interlaced ropes for springs and a straw filled tick mattress.

Despite the crude looking bunk, Ed was asleep almost immediately and didn't wake until he heard Walt chopping wood next morning.

The coffee was already warmed over again and the beans were hot, so breakfast was ready.

"Where's the bathroom?" Ed asked.

"Down at the creek, if you want to wash your face," Walt told him. "Here's soap and a towel."

The water was cold as ice when Ed splashed gingerly and wet his face with the tips of his fingers.

After breakfast they smoked and talked awhile and Ed mentioned fishing.

"Oh, yes, we'll go fishing, maybe this afternoon. This morning I want to work on a water power electric plant and I'd like some suggestions from you. I wanted to get it finished before you got here but didn't make it. Two of us working on it will get the job done pretty quick. Then when we get the house wired we can go fishing. The whole job won't take over three or four days."

Two days later Ed received a message from the boss. "Go to Amarillo, Texas, soon as possible. Writing you there."

"Gosh, hate to see you leave before we get the wiring done," Walt said, "and I did hope we would get to go fishing."

"I had planned on a little fishing," Ed said. "Next time I think I will."

THE WHITE HOUSE
WASHINGTON

June 7, 1945

Dear Colonel Johnson:

The transportation facilities of the nation are now called upon for the most gigantic task in all the history of transportation. The American armies must be moved from the victorious battlefields of Europe to meet and wipe out the tyranny of the East. In order to do this job most of our soldiers will be transported the full length of the American continent.

It required every transportation ingenuity to assemble our armies in Europe over a period of four years. This time the job is to be done in ten months. The contemplation of this task would overtax our faith if we had not found during the course of this war that the impossible has become our daily job.

I am asking you to extend my congratulations to all of our transportation agencies--and their millions of workers--on the results they have accomplished. At the same time express my confidence in them for the greater effort that lies ahead.

Sincerely yours,

Harry Truman

Honorable J. M. Johnson
Director
Office of Defense Transportation
Washington 25, D. C.

For DISTINGUISHED SERVICE in war transportation I, as directed by the President, present this to RAILWAY MECHANICAL ENGINEER with my congratulations.

J. M. Johnson
Director
Office of Defense Transportation

EDITORIALS

President Truman Commends the Railroads

The letter from the White House reproduced on the opposite page was received by the editor of the *Railway Mechanical Engineer* with the following letter from J. M. Johnson, director, Office of Defense Transportation, Washington, D. C.:

"I am enclosing a letter from President Harry S. Truman, dated June 7, 1945, which expresses the President's appreciation of and faith in our wartime transportation. To this I have added my official congratulations.

"Your publication has well performed an important part in the war effort by informing those who supply and use transportation of its accomplishments and the difficulties which must be surmounted in meeting the national needs.

"For Railway Mechanical Engineer's service which I consider above the average and to each individual laboring in transportation who has, and will, perform such service, I add my sincere thanks to those of the President."

Director Johnson's opinion is a source of satisfaction to every person on the staff of this publication.

A Railroad Experimental Shop

At least one suggestion, advanced by F. K. Mitchell, assistant general superintendent of motive power of the New York Central, in a committee report prepared for the 1944 Year Book of the Locomotive Maintenance Officer's Association, deserves special emphasis due to its novelty and potential value in promoting improved equipment maintenance practices. Because most railway shops are long-established institutions in this country and have made enviable production and employment records in the past, there is altogether too great a tendency to assume that shop equipment and shop methods used by railroad men of an earlier generation are adequate today.

Quite the contrary is true and an alert shop supervisory force, whether engaged in locomotive or car maintenance work, is always on its toes to effect improvements which will increase either the quantity or quality of shop output. As a definite step in this direction, Mr. Mitchell's report suggests setting up a separate experimental shop, presumably at not less than one major repair point on each railroad, where new shop tools, machines and methods can be developed, perfected and demonstrated, without interfering with the normal shop output.

In times like the present, when it is difficult to get the machines and manpower for repairing equipment as fast as necessary to meet war and civilian rail transportation requirements, probably little can be done towards getting these experimental shops equipped and in actual operation. It is not too early to start plans for at least the equivalent of an experimental shop and organization equipped to extract the best practices of progressive railroads, as well as other industries, and adapt them to local needs.

Obviously, the planning should also go far enough to project means for capitalizing fully on the work of the experimental shop on a system-wide basis, since the development of a thoroughly tested, checked and approved new method only initiates the real job of getting this method generally accepted and adopted.

Electrical Maintenance Of the Diesel Locomotive

With the increase in the use of Diesel-electric road locomotives there has been a corresponding growth of service and repair facilities. Road operating requirements are more severe than those of switching service and there are still in effect operating practices which take an unnecessarily heavy toll because traction motors are allowed to get too hot or to heat too quickly, causing relative movement between coils and core.

In the process of developing Diesel facilities each road using such power designs and builds a plant suited to its specific operating requirements and is usually guided by the recommendations of the manufacturer.

Probably the greatest variation of practice is to be found in the equipment used for electrical maintenance. This is caused by the fact that there are two schools of thought. One advocates doing as little as possible in a railroad shop, leaving major items such as rewinding to the manufacturer or outside service shop, and the other which wishes to keep all maintenance procedure under complete control of the railroad. For this reason, and because requirements are inffuenced by operating conditions, the plant installed by one road may not in detail be suited to the needs of another.

Basic needs are, however, common to all and these are covered effectively in a paper written for the American Institute of Electrical Engineers by N. J. Greene, D. E. Stafford and C. Gentilini of the National

Electric Coil Company. An abstract of the first part of this paper appears elsewhere in this issue. Such information should serve as a guide in determining what a railroad should do to meet its own requirements and what kind of tools and procedure are required to do the work. It offers no recommendation concerning the desirability of doing the heavy work in a railroad shop or having it done outside, but it serves effectively to show the importance of careful work and proper materials and methods. When all railroads have learned what operating and maintenance procedure will give them the best performance from their electrical equipment, Diesel maintenance costs will drop appreciably below their present level.

Safety Knows No Compromise

The mechanical condition of freight-car equipment has been getting steadily worse despite the best efforts of car-repair forces during the war years. This deterioration has been commented on from time to time in these columns, always with the expressed conviction that inspection and repair were still sufficient to insure safety in the operation of trains. Now many cars, not in safe operating condition, are in revenue service on the railroads, and unless measures are taken to remove them from service the trend in accidents caused by defective equipment is going to be upward.

Evidence to support this belief is available in any major classification yard today. That the situation is serious to the point of being critical can be further seen in the comment of one car-department head of many years' experience. It was to the effect that he would tie up his own railroad, and could tie up anybody else's railroad, by setting out all cars having A. A. R. defects. As matters are now, the inspectors try to catch the worst cars and hope for the best on the rest. With such a system, dependent on judgment as to the degree of danger involved in passing up defects, some bad risks are getting by.

A car-inspector foreman on another railroad stated that his policy had to be to shop cars only to the extent that the rip-track forces could handle them. His estimate was that, for all kinds of defects, his men could shop at least four times the number of cars that they did. Here, again, the policy was to try to catch the bad ones. The others moved as serviceable cars although many of them were as bad as the cars marked out. Almost every such supervisor faces similar situations and others have admitted informally that their procedures are about the same.

On still another railroad, a foreman car inspector estimated that he was sending home under the A. A. R. emergency order of May 10 relative to home shopping of cars requiring extensive body repairs, only one in eight of those which should be so handled. Such cars, of course, are rarely in good condition mechanically. This is also true at other points and on other roads with estimates varying from one in three to one in ten.

Some roads require all cars set out to be repaired and released within 24 hours. Others apply such a ruling only to loaded cars. It is safe to say that no car-repair point in the country today has the men or facilities to handle in any 24-hour period all cars that inspectors can mark out in the train yard. So, while the record report may be kept clear, some cars are going out lacking essential running-repair attention.

Hot boxes, resulting in burned-off journals, have been discussed within the past month with three different railroads in quite widely separated operating territories. One had had three in two weeks, another three in seven, the third, four in six. In one case on each of the first two roads, the cars involved were less than 12 hours off the repair track. With practically all roads experiencing an increase in hot boxes out of proportion to the usual and expected seasonal rise, more journals will burn off and more trains be derailed.

The car department is fighting, right now at least, a losing battle. No indictment of them is intended, however, in this recital of evidence of an existing and dangerous situation. It exists as a result of many circumstances which are essentially beyond their control. The important thing now is not to attempt to allocate or apportion blames. It is to stop attempting to compromise with safety.

Background Facts Are What Count Most

It seems to be characteristic of railroad executive officers, in the interest of efficiency and progress, periodically to call their operating and mechanical department men "on the carpet" and confront them with either operating records or maintenance cost statistics which have been made public by other railroads in the country, with the query, "Why can't we do as well as they can?"

Through all the years the steam locomotive has been operating it has been common practice to compare the maintenance costs per locomotive-mile; per thousand pound tractive-force-miles; or per thousand gross ton-miles for steam locomotives, with similar figures that have been or can be compiled in connection with the performance of neighboring roads. Fuel performance, also, is another very convenient basis upon which to ask mechanical and operating men those embarrassing questions as to "why some other railway can do better than we can." This continual comparison with the costs and performances of other roads, is without doubt a very worthwhile part of the routine of railroading, although we have always entertained the suspicion that the railroad officer who asks these questions knows the answers to them before they are asked.

Those who have been confronted with this situation with respect to steam locomotive performances for many years may take some comfort in the fact that some of

the claims which are now being made for operating costs and performance of Diesel-electric locomotives appear to be just extravagant enough that there is skepticism on the part of many railroad men as to their actuality. Just take the matter of Diesel freight and passenger locomotive operating costs, for example. In a recent issue of this publication there appeared in an editorial discussing the matter of riders on Diesel power, some cost figures and labor and material relationships involved in Diesel repair work. It is but natural, in view of the variety of conditions under which Diesel-electric power operates on the railroads scattered over this country, that conditions on one road can be so greatly different that it is perfectly obvious that the cost figures on one road should be and are considerably higher than on some other road.

The matter of total mileages made by Diesel-electric locomotives between shoppings for general repairs is another matter that is causing some concern among railroad mechanical and operating officers. There have been many performance records where 600,000 to a million miles have been run between shoppings, and it is but natural for those who are skeptical to point out the fact that in this term of service many of the units of Diesel-electric locomotives, such as trucks, power plants and individual engine and electrical parts, have been replaced—so much so that, as one mechanical man put it, "There is nothing left of the original locomotive at the end of the million miles but the underframe and the number."

There is, however, one thing to remember, and that is that a locomotive, whether it be Diesel-electric or modern steam power, is an operating tool that is of value to a railroad only when it is being or can be used. From a mechanical man's standpoint there may be some significance in the fact that a million-mile-locomotive has very few of its original parts left, but from the operating man's standpoint, the important thing is that the mere process of changing those parts gave that locomotive an availability of 90 or 95 per cent.

Getting Output From a New Machine Tool

Among the wheel shops of the country in which many thousands of dollars have been invested in new machine tools and shop equipment in an effort to improve the accuracy of the finished product and the output of the shop is one on an eastern railroad where about $100,000 was spent within the past year. Almost a fifth of this money went for a new hydraulic-control wheel borer with the full confidence that, because of the greater production capacity of the new machine, between $3,500 and $4,000 annual savings would result.

This shop has been operating for years with two wheel-boring mills, now over 35 years old, which have a combined productive capacity of 40 wheels in an eight-hour day, each machine requiring the services of an operator. The new machine had an estimated output of 70 to 80 wheels a day and it was proposed to fill the wheel-boring requirements of the shop—which, incidentally, right now, is turning out from 1,500 to 2,000 mounted wheel sets a month—by the use of the new machine and the best of the two old machines—still two operators, but an expected 250 per cent increase in output.

The shop management, however, overlooked the attitude of the shop committee toward matters of this kind and, when all the argument was over, the new machine was found to have an output of 20 wheels a day—the same as the old ones—through various and devious caprices of human nature, by which the operator of the new machine, for example, developed illnesses that required such extended periods of rest that he could only work about one-third of the time.

This writer, being in a somewhat detached position with respect to matters of this kind, asked "What can you do about such conditions?" and the answer was "Not much just now." That, it seemed, was an unsatisfactory answer, so, a day or two later, in conversation with a shop man on a neighboring railroad we asked again, "What can be done about such conditions?" This time we got an answer, and were told that almost identical circumstances had prevailed in his shop a short time before in connection with the installation of an identical machine. The "slow-down" operator, in this case, along with his craft representative, was told that the railroad had invested $20,000 in that machine and expected to get out of it what they paid for it.

Several maneuverings among members of the machinists group resulted in a succession of operators on the new machine whose terms of service were relatively short until, finally, a young machinist, not long out of his time, bid the job and got it, without opposition.

In the meantime, something happened to the two old boring mills that had been doing business for about 40 years and, "there being a war on and no repair parts," the company just had to scrap the old machines—really nothing else to do about it—so they were left with nothing but the new machine and a new operator who evidently hadn't been around long enough to learn how to make a good job last a long time.

Business being what it is and every rip track and shop on the railroad yelling loudly for wheels, and more wheels, the new operator stretched himself one day and turned out 102 wheels on the new machine.

There's a little arithmetic involved in this performance. In an eight-hour day there are 480 min. and at the 102-wheel output the average floor-to-floor time is about 4.8 min. The new machine is equipped with tools and handling equipment that makes the 102-wheel output an easier job than the 20- to 35-wheel output of the old machines.

If there are any better examples of the value of retiring obsolete machine tools and acquiring modern machines and tooling facilities, we'd like to know where they are.

Rewinding Traction Armatures

Part I

By N. J. Greene, D. E. Stafford and C. Gentilini*

A summary of the best practices for maintaining motors in first-class operating condition

WITH the increased number of electric and Diesel-electric locomotives in use, the longer hours of operation, and the heavier loads, old maintenance problems have been accentuated; new ones have arisen. Down the long list of these problems is one entitled "Armature Rewinding."

The object of this paper is to review for those experienced in the art of armature rewinding and to cite for the newcomer some of the important and frequently overlooked factors which must be considered to restore a damaged armature to its original condition and to modernize and improve, consistent with current practices.

Railway armatures present an interesting though difficult problem since they must withstand the severe strains imposed upon them by varying loads at varying speeds** plus the several combinations of vibrations and strains resulting from train motion and roadbed shock, and often with rapidly changing ambient temperatures.

Analysis of Failures

Traction motors are of necessity rugged in design because of inherently severe duty requirements. The kind of service is such that road failures must be kept at a minimum, not only because of the direct cost but because of the consequent expense incurred when traffic movement is obstructed. In most industrial plants a replacement motor or part can be installed in a comparatively short time. With motive power, however, the point of operation is not fixed and failures may occur many miles from the nearest repair or exchange facility.

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** Abstract of a paper recommended for publication by the Committee on Land Transportation, American Institute of Electrical Engineers.

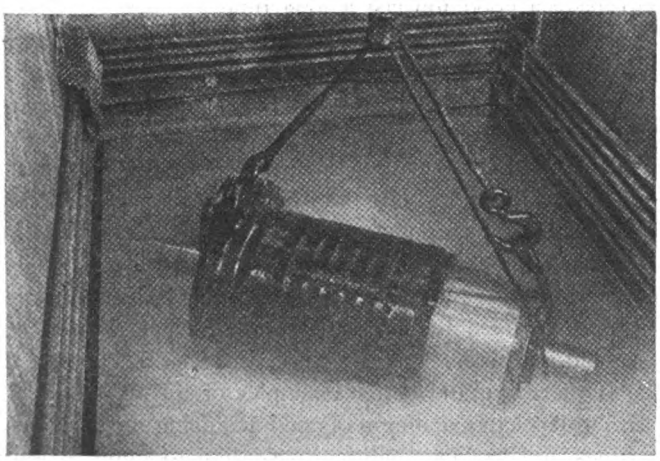


Fig. 1—Vapor cleaning tank

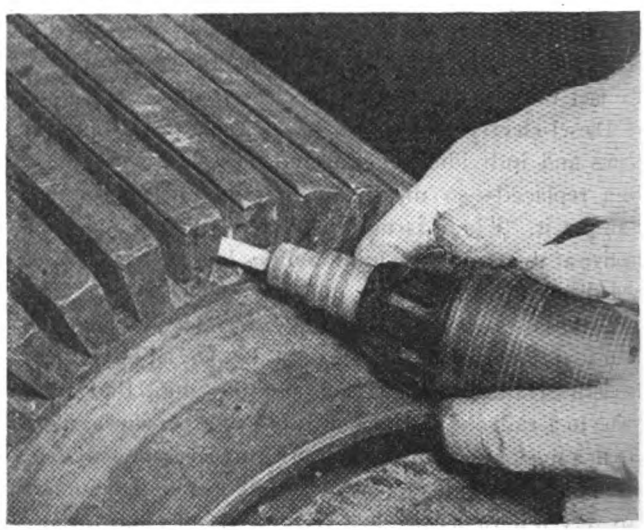


Fig. 2—Clearing surface-fused laminations

In spite of equipment design and operating precautions taken to prevent failures, they will happen. To minimize these failures, an analysis of the cause of each must be made and steps taken to lessen the possibility of a recurrence. Causes of armature failure can be divided into two classes: (1) those which can be attributed to faulty operating conditions, and (2) those originating within the motor due to mechanical or electrical defects.

Causes of armature failures may be numerous and varied; however, some of the major and frequently occuring troubles are discussed in the following paragraphs. The armature winding may be completely roasted because of a mechanical fault causing excessive overload; it may be roasted because of heat resulting from friction generated when worn-out bearings or journals allow the armature to rub the pole pieces. The armature winding or commutator may be grounded, short-circuited, or open-circuited; bands may fail due to overspeeding, but in all cases the cause can be assigned to either the category of faulty operation or to that of a defect in the motor proper.

Most failures traceable to a motor defect originate first as a mechanical failure. Improperly seasoned arma-

ture insulation caused by incorrect baking and hot banding procedure may permit relative movement of wires or coils which will cause actual mechanical destruction of the insulation and result in an electrical failure. Faulty commutator seasoning on high-speed traction motors, weak brush-holder spring tension, and short or binding brushes are only a few additional things to consider when analyzing armature failures. The advantage of a thorough investigation to determine the cause of each failure cannot be stressed too strongly.

Cleaning and Preparation of Core

The proper cleaning of cores to be rewound goes beyond removing the old coils and scraping out the slots. Grease must be removed, old paint must be stripped,

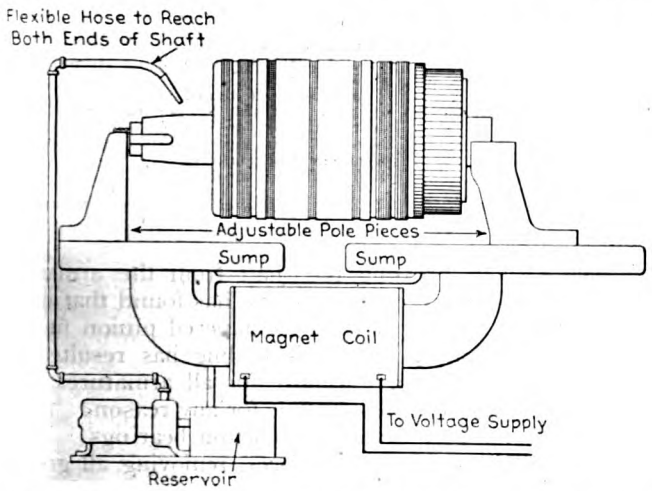


Fig. 3—Traction armature in position for magnetic inspection of shaft

vent ducts cleared, and the outer surfaces of laminations cleaned. One of the most effective methods of accomplishing these aims is by the use of hot vapor cleaning—a process termed by the sheet metal industry—"degreasing." The equipment consists of a heated tank with a few inches depth on the bottom of the liquid cleaning solution (normally trichlorethylene) and a water-cooled condensing coil around the tank about half way up the side wall.

In operation, an armature to be cleaned, with its old winding intact, is lowered into the gaseous medium existing between the boiling pan and the condensing coils. As the vaporized cleaning solution is kept at a temperature of 188 deg. much higher than the object being cleaned, the vapor condenses upon the object, attacking grease, dirt and varnish. Condensation is so rapid that the fluid flows from the work in a steady stream, carrying with it dissolved materials. Upon first seeing this action, one would think that liquid was being fed onto the object from an invisible pipe line.

When the entire armature is placed in the tank, not only is the grease and dirt removed but the insulating and bonding varnishes are softened, facilitating the removal of the old winding. This procedure minimizes the hazard of lamination damage when extremely tight coils must be stripped from the slots.

After the temperature of the work has reached that of the vapor, condensation ceases and the cleaning process stops. The armature may be withdrawn from the cleaning tank, and a few strokes with a wire brush removes loose residue and flakes of varnish. If the slots have been dirty, it may be necessary, after removing the coils, to return the stripped core to the cleaning tank for another treatment; but a second cleaning is only occasionally required.

The solvents normally used in this type of apparatus have little or no dissolving effect upon some types of coating materials such as shellac and certain synthetic enamels. The vapors have no effect on water glass (silicate of soda) or other standard lamination insulating varnishes. Tests reveal that, after these lamination insulating materials have been suspended in the degreasing vapors for ten minutes, neither their surface smoothness nor adherence to the metal has been affected. A mica commutator segment and cone ring given the same treatment were found to have a very small increase in weight, which was caused by the shellac softening under heat and allowing some vapor to collect. This increase in weight was lost after cooling took place, with no damage to the mica splittings or the shellac bond.

Over a period, repeated dips and bakes build multiple layers of baking varnish on the laminations, in the radial vents, and in the longitudinal core ducts. This insulating coating retards heat transfer and restricts air flow. The removal of this varnish in the "degreaser" will restore original ventilating efficiency to the armature. The elimination of grease from commutator, mica, and cone rings provides a clean surface to which insulating and protective coatings may be applied.

Core laminations of armatures which have failed are frequently found to have been damaged by arcing in slots between conductors and core. Also, the outer surface of core may have been defaced by pieces of conductors or bands being caught between armature and pole faces. Where any of the damage is severe, new core stacking may be necessary. However, after most armature failures, core-stacking will not be required.

A very effective method of removing the fused surfaces in the core slots is to grind them out with a high-speed, portable tool as shown in Fig. 2. Sufficient grinding should be done to clean up all short circuits between laminations. Otherwise, hotspots may be expected to

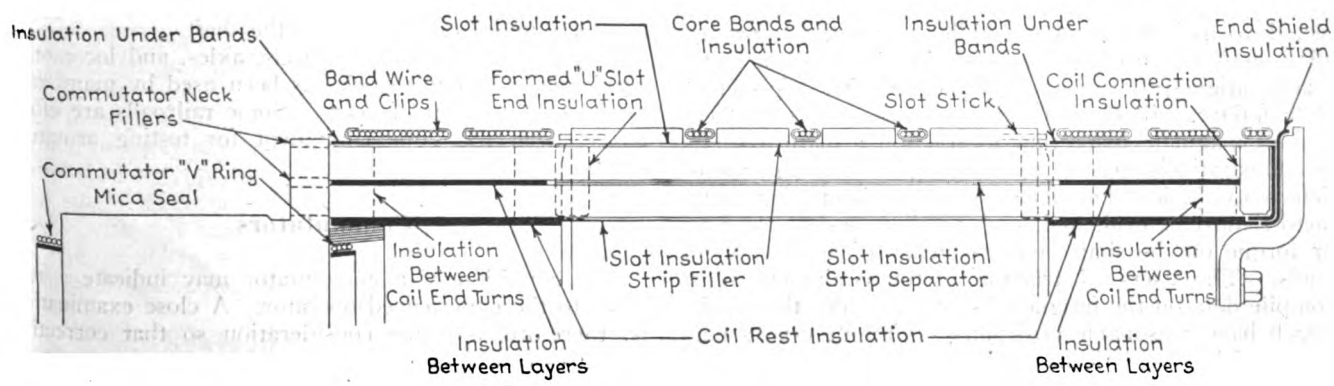


Fig. 4—Guide for armature rewinding materials

Guide for Armature Rewinding Materials

	Position	Use with AIEE Class A coils	Use with AIEE Class B coils
Core type:	Coil rests	Pressboard or tapings of varnish cloth and cotton tape	Flexible mica, oiled asbestos paper or .030-in. varnished glass cloth, tapings of glass tape, moulded mica rings
	Coil shield	Rope paper and varnished cloth	Flexible mica and .030-in. varnished glass cloth, moulded mica rings
Slot type:	Troughs or cells	Fish paper or high density rag paper	Preferably none—use uncut mica if filler is needed
	"U" end piece	Rag pressboard	Treated asbestos tape
	Bottom fillers	Pressboard, fish paper, or high density rag paper	Sheet bakelite, oiled asbestos paper, or moulding mica
	Coil separators	Pressboard, fish paper, or high density rag paper	Sheet bakelite, coil asbestos paper, or moulding mica
End type:	Between layers	Treated duck or rag pressboard	Oiled asbestos paper
	Between leads and knuckles	Treated duck or high density rag paper	Flexible mica or .030-in. varnished glass cloth or Mica-Glas combination
	Between knuckles or rear coil connections	Treated duck or high density rag paper	Flexible mica or .030-in. varnished glass cloth or Mica-Glas combination
	Between coil end turns		Glass, asbestos, or canvas-base bakelite, moulding mica
Wedges or sticks:	Coil retainer or protective strip	Canvas-base bakelite	Asbestos-base bakelite, glass-base bakelite, or canvas-base bakelite
Band type:	On core	Fish paper, rag paper, or rag pressboard	Uncut mica or varnished asbestos paper
	On coils	Treated duck, fish paper, or high density rag paper	Flexible mica and oiled asbestos paper or varnished asbestos cloth
Misc. types:	Commutator seal	1/16" flax cord painted with red commutator enamel	1/16-in. glass braid painted with red commutator enamel
	Band wire	Tinned steel, Grade C-1, or tinned 18-8 stainless steel	Tinned steel Grade C-1 or tinned 18-8 stainless steel
	Band clip	Tinned steel or tinned copper	Tinned steel or tinned copper
	Solder	50 percent tin—50 per cent lead, or alloys upward to 100 per cent tin	100 per cent tin, 95 per cent tin—5 per cent antimony, or high-temperature alloy
	Flux	Non-acid rosin flux	Non-acid rosin flux
	Dipping varnish	Synthetic black baking	Synthetic black baking
	Spray varnish	Black oilproof air-dry	Black oilproof air-dry

occur in operation, their severity depending principally upon the amount of fusion, the relative location, the magnitude of the armature current, and the frequency.

On older-type armatures having core bands, it is often desirable to true up the banding grooves before rewinding. They are often burred over by the tangled mass of banding wire and copper that sometimes gets between the armature surface and the pole piece. An often-used practice for accomplishing this is to drive a hard maple block into each slot, filling to the bottom of the band groove and then with the armature turning in a lathe, true up burred-over laminations at edges of band groove, taking light cuts with a high-speed, tool-post grinder.

Magnetic Inspection

Magnetic inspection is the term applied to the process of examining ferrous metal pieces for flaws by magnetizing the piece and dusting fine iron particles or flowing over the piece a solution with iron particles in suspension. Since different magnetic poles are formed at the cracks, a concentration of the magnetic particles will collect so that the defects can be found by visual inspection.***

Magnetic inspection, although not new, has come into common use only since the great forward developments of aircraft, which must, of necessity, use materials efficiently to achieve lightness and safety. Railway equipment, although not limited to the same extent as that of aircraft, is subjected to repeated stresses that may cause costly failures. Armature shafts are continuously subjected to twisting torques while rotating. Improved alloy steels are used for these shafts; however, a metal that is fatigue-proof is not available. Shafts, before complete failure, will develop fatigue cracks. The application of magnetic inspection to traction armature shafts is comparatively recent, and only a limited amount of data is available. The available data indicate that many factors must be evaluated, such as shaft design, the load or torque on the shaft, and frequency of application of loads. The users of traction motor equipment must compile data on the fatigue of shafts in order that shafts which have reasonable possibility of fatigue cracks may be tested by magnetic inspection.

The general practice in the magnetic inspection of traction armature shafts is to apply the test to exposed surfaces without pressing the shaft from the armature core. One Class I Western railroad has found that most fatigue cracks are detected on the tapered pinion fit adjacent to the bearing fit. This finding has resulted in the following handling procedure for all armatures that are removed from the motor frame for any reason:

1—Remove the pinion and anti-friction bearings
2—Clean all exposed shaft surfaces, removing all grease and dirt
3—Magnetic test and inspect for fatigue cracks, fractures, and defects
4—Check for shaft trueness and alignment
5—Renew defective shafts

Fatigue cracks in armature shafts are not limited to the zone between the bearing and pinion fit. If a complete check is wanted, the shaft must be removed and tested over its full length.

Various types of equipment are available for performing magnetic inspection. Some use alternating current, some direct current from storage batteries, and others use rectified alternating current for excitation of the magnetic structure. Any type excitation is generally suitable for inspecting traction motor armature shafts for fatigue cracks. The equipment for checking consists essentially of a magnetic yoke assembly with adjustable pole pieces for contacting the ends of the shaft and an excitation coil with control for allowing current to flow in the coil for comparatively short intervals (.00001 to 3 sec.), similar to that shown in Fig. 3. Magnetic particles in liquid suspension are easier to use, since the solution may be pumped or flowed over the shaft.

Magnetic testing of the wheels, axles, and locomotive crank pins of rolling stock has been used by many railroads for a number of years. Some railroads are effectively using the same equipment for testing armature shafts.

Commutators

The condition of a commutator may indicate a real story to the experienced operator. A close examination is, therefore, a prime consideration so that corrective measures can be taken if necessary.

NEMA Standard RP4-20 specifies that the Brinell hardness shall be 75 for bars of .125 inches and less at

the thick edge, 70 for thickness of .125 inches to .250 inches, and 65 for bars over .250 inches. When a commutator shows evidence of having been very hot, it is good practice to test the hardness of the bars and to replace those which are too soft. It is also important on commutators of high peripheral speed that the amount of bar stock depthwise be checked so that there will be no danger of the bar bowing outward because of centrifugal forces. When in doubt as to the depth of the bar remaining, a check with the commutator manufacturer is warranted. If the depth is less than a safe value, the commutator must be renewed.

After the winding is removed from the armature, the commutator slots are cleaned for the new coil leads, all burrs and fins are removed, and the commutator is given a ground test with the proper test voltage as specified by AIEE Standards. The authors have been unable to find a published Standard for a bar-to-bar test but have very successfully used a value of 220 volts alternating current, 60 cycles.

If the V-rings are loose or have been disturbed, the commutator should be seasoned before again placing the armature in service. Many different practices are followed in the seasoning of commutators, and most of them have good points. The object of seasoning is to obtain a tight commutator that will not develop high and low bars after being placed in service. To accomplish this objective we must apply the same elements that produce distortion in service, namely, heat and centrifugal force. The commutator assembly may be rotated in a heating rig and the bolts uniformly tightened at intervals. For the required uniformity in tightening the clamping bolts, it is recommended that a torque wrench be used.

As little copper as possible is removed from the commutator in turning and truing. The point of the tool should be rounded so that a smooth surface results. Final surfacing can be done with a stationary stone mounted in the tool post with the armature running at a high speed. A final polish may be given with a hand stone or very fine sand paper. The commutator should be true within .001 inches for any high-speed motor. Where greater precision is wanted, the commutator may be ground with a carborundum wheel while the armature is rotated at full speed in its own bearings in a special grinding rig.

Undercutting of commutator mica segments first came into use over 35 years ago, and though at first it was not accepted, there is today little occasion to doubt its merits. However, expert care must be exercised in the operation, or the merits of undercutting are lost. It is very important that all mica fins be removed as they are frequently the source of unsatisfactory operation. After undercutting, the rough corners of the copper bars must be removed.

After the commutator has been finished, it should be thoroughly cleaned and the armature blown out to remove all the copper chips and dust. It should be carefully inspected and then given a ground test according to AIEE Standards.

The protection of the outside surface of the V-ring mica that projects beyond the commutator can readily be accomplished by applying a coat of shellac, running over this a single layer of Fiberglas braid, and coating repeatedly with red enamel, sandpapering between coats. This will result in a very smooth surface which will minimize the collection of dust and oil.

Rewinding Materials

An often overlooked important element of armature rewinding is engineering planning of the rewinding materials. Rewinding materials include all insulation, solder, band wire and the like material, exclusive of the coils. Fig. 4 gives the location of various items of rewinding material, and the table therewith will serve as a general guide as to good practice in the use of material with A. I. E. E. Class A and Class B windings. Precision armature rewinding necessitates complete drawings of the armature assembly and they should be accompanied with detailed instructions on the method of application of each of the items of rewinding material. Information gathered from the analysis of failures is a part of the engineering data which is required for preparation of these rewinding specifications. Each item of rewinding material must be engineered for its job.

Too often certain items of insulation are applied to an armature because it has been customary to use insulation in that particular spot on similar equipment. Frequently overlooked in applying rewinding insulation are the formation of pockets for trapping carbon dust and other foreign material; obstruction of ventilation; formation of dead air pockets; and the use of materials that are heat insulators. These factors weigh heavily in the selection of proper rewinding materials. The material under the bands may be taken as an example. This material should preferably be of a cushioning nature such as varnished asbestos cloth or paper, in order that the material will not chafe and disintegrate when affected by winding movements resulting from expansion, contraction, acceleration, and deceleration.

Economical rewinding requires that many items of the insulation be precut and fabricated. Volume production permits the use of tools and dies for shaping the rewinding material to greater accuracy than is possible by hand cutting and shaping. Better quality workmanship may be expected by the use of packaged, pre-cut rewinding material along with complete instructions for its use.

(To be continued in the September issue)

Train Communication In Electrified Tunnels

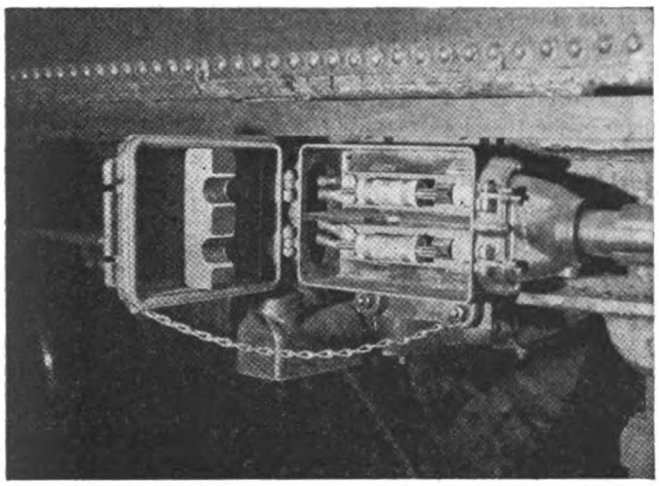
The Chicago, Milwaukee, St. Paul & Pacific has conducted tests of the Union Switch & Signal Company's system of inductive train communication of the electrified territory, 440 miles between Harlowton, Mont., and Avery, Idaho, and 216 miles between Othello, Wash., and Seattle-Tacoma. The first item was to determine whether the train communication would operate satisfactorily under the overhead catenary energized at 3,000 volts d-c. and with a wayside power circuit at 100,000 volts a-c. Also it was quite possible that the traction motors on the locomotive, when pulling or when being used in regenerative braking, might cause interference with the train communication. In brief, no such interference was encountered at any time during any of the tests.

A second purpose of the test was to learn if the train communication would operate properly when the locomotive and/or the caboose were running through the numerous tunnels including the Snoqualmie tunnel through the Cascade mountains which is 11,890 ft. long and 1,500 ft. below the surface of the ground at the deepest point. Numerous tests proved that the inductive communication system operated satisfactorily not only when the train was in tunnels, but also when in deep gorges or alongside rivers.

Head-End Train Lighting

Jersey Central to equip 60 locomotives and 300 cars—Battery charging lines are used for a. c. standby terminal service

THE Central Railroad of New Jersey is now in the process of equipping suburban trains operating out of Jersey City, N. J., with head-end lighting, power being supplied by a steam-turbine-driven generator mounted on the locomotive tender. The trains serve commuter traffic in and out of New York City, connection being made by ferry between Jersey City and New York. Nine trains are now equipped, one making a daily round trip between Jersey City and Barnegat, N. J., another running daily between Jersey City and Freehold, N. J., and seven main line trains operating between Jersey City and Dunellen, N. J. A total of 17 locomotives and 60 cars are now equipped. The ultimate program will include 60 locomotives and 300 cars of which 40 locomotives and 200 cars have been authorized.



Weather-proof enclosure for fuses mounted on one side of the tank sill—Note wooden block fastened inside cover to prevent fuses working out of clips

The installation is being made to provide the best lighting for this type of service which involves short runs and frequent stops, and to do it at a minimum cost. The system is limited in that it must be used with locomotives and coaches equipped for this type of lighting but it represents the ultimate in simplicity and ease of maintenance and will be standard on all Jersey Central suburban runs. It assures constant voltage on the lights, disposes of battery charging and many maintenance problems and removes about 4,000 lb. of equipment from each car.

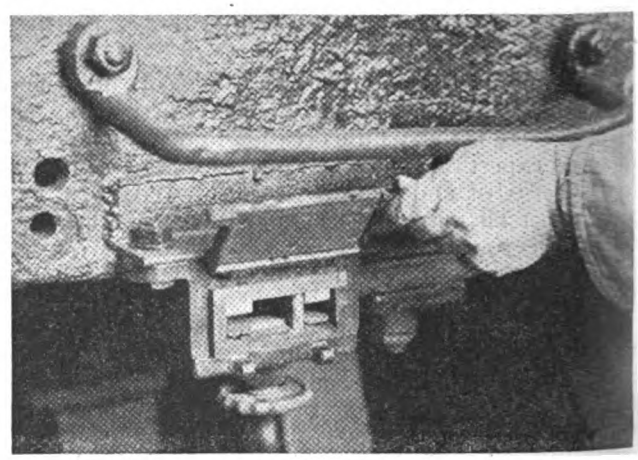
Train Equipment

The lighting load on each car is 950 watts and consists of eight 100-watt lamps in dome fixtures arranged along the ceiling of the car, four 25-watt vestibule lights and one 25-watt light in each of the two toilets. The circuit-switch panel is located in the men's toilet and the circuit switch for the toilet light is held in the closed position with a cotter pin. A toggle switch on the wall outside the door is wired in series with the switch on the panel. This arrangement allows the trainmen to turn on the toilet light from the outside and avoids the need of groping in the dark for the switches on the panel.

The turbo-generator sets which supply power for the trains are 125-volt Pyle-National machines and are mounted on the rear of the tender immediately behind the water hole. All but ten will be 12-kw. sets, 7½-kw. machines being used on smaller locomotives which are used for shorter trains. The 12-kw. sets will be used on trains up to thirteen cars and on test showed a capacity sufficient for fifteen. Barco flexible couplings are used between the locomotive and the tender in the steam line to the turbine. There is a steam valve in the locomotive cab for controlling the steam to the turbine but there is no switch in the generator circuit.

Leads from the generator are carried down through the tank in a pipe, welded top and bottom, to a Colt no-arc weather-proof enclosure, containing two 200-amp. cartridge fuses mounted on the side of the tank sill at a location convenient for inspection and replacement of fuses. A wooden block on the inside of the box cover prevents vibration from working the fuses out of the clips. From the enclosure, the leads are carried in conduit to a two-wire receptacle at the rear of the tank and another at the front of the locomotive, since the locomotives are required to run in both directions.

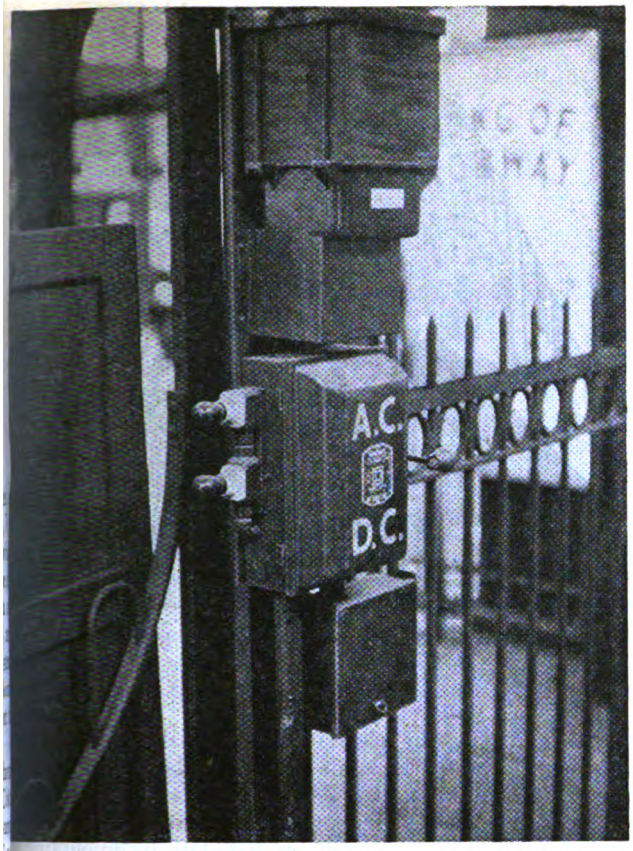
Three-wire train lines are used which consist of 2/0 flexible rubber-covered wire in 2-in. conduit run under the bodies of the cars on the side opposite the steam pipes.



A two-wire train line receptacle as mounted on the back of a tender—Similar three-wire receptacles are mounted under the end sills of each passenger car

Three-wire, Pyle-National receptacles are mounted on the left side of each car and connectors between cars are supported at their midpoint on hooks made of twisted flat iron which make a quarter turn of the hanger necessary for application and makes its bouncing off impossible.

Lamp circuits in the cars are connected to train line

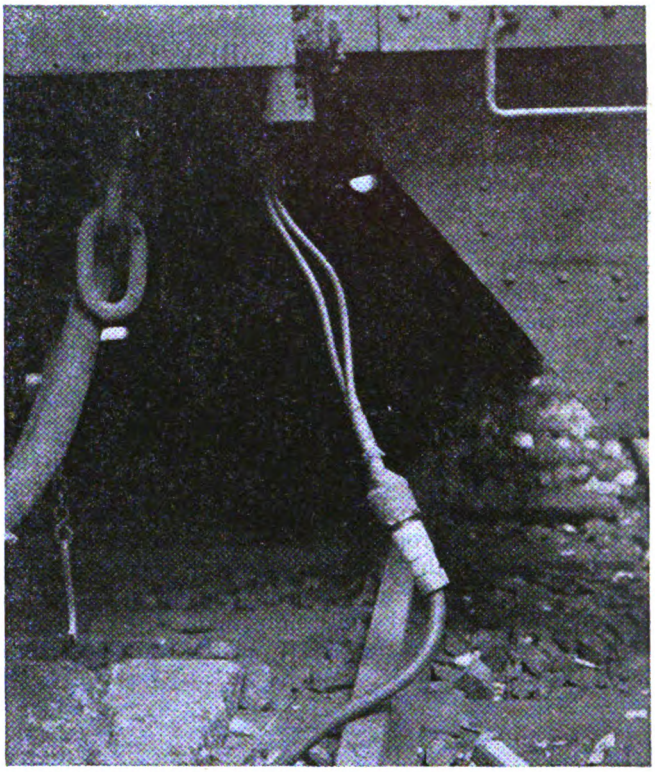


One of the one-to-one transformers, double-throw switch, pilot lights, and at the bottom, an enclosure for fuses protecting the a.c. circuit

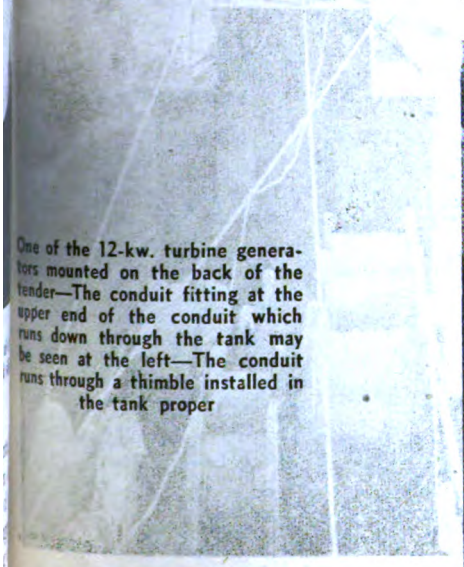
No. 1 and No. 2 while the generator is connected to the No. 1 and the No. 3 or loop wire. The loop wire is connected to train line No. 2 at the rear of the train, this connection being made automatically in the last receptacle. When there is a train-connector plug in a receptacle, the connections are carried straight through, but when there is no plug, contacts No. 2 and No. 3 are connected together. Thus the current from the generator flows through train line No. 1 to the lamps and then through train line No. 2 to the rear of the train returning to the generator through the loop or No. 3 line. This arrangement makes the line resistance drop to each lamp the same and equalizes the socket voltages throughout the train. Lamp-socket voltage is maintained at 120 and voltage at the generator is 126 on a ten-car train, compounding of the generator compensating for changes in load caused by changes in the number of cars in the train.

Terminal Power Supply

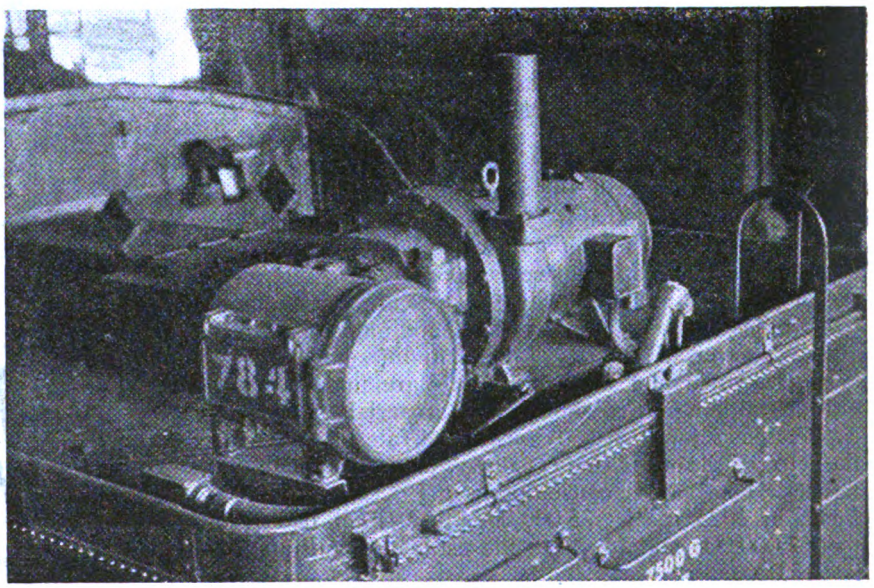
When a train is standing in the Jersey City terminal it is often necessary to have lights in the cars before a locomotive is attached to the train. By means of a simple and ingenious arrangement of connections, the necessary power is supplied to the train from the a. c. power circuits in the terminal. The battery charging lines in the terminal are made to serve as a. c. lines for lighting as well as for battery charging of through line cars which leave the same terminal.



One of the a.c. service jumpers as connected between a charging lead terminal and a three-wire receptacle on a car



One of the 12-kw. turbine generators mounted on the back of the tender—The conduit fitting at the upper end of the conduit which runs down through the tank may be seen at the left—The conduit runs through a thimble installed in the tank proper



A double-throw switch is mounted in a cabinet at the bumper block on each track with its center poles connected to the charging line. When the switch is thrown down, d. c. charging current is connected to the lines. When it is thrown up, 120-volt a. c. power is fed to the lines through a one-to-one isolating transformer which keeps grounds on the charging lines off the a. c. supply lines and avoids a. c. voltage to ground in the cars. When the switch is in the "up" position, a third contact closes a circuit to two pilot lamps mounted outside the cabinet. These lamps can be seen from any one of the charging outlets served from the switch cabinet. Two lamps are used to protect against loss of signal by a lamp failure. Overload protection of the transformer is provided by fuses in the a. c. circuit between the transformer and the double-throw switch.

Switching from A. C. to D. C. Power

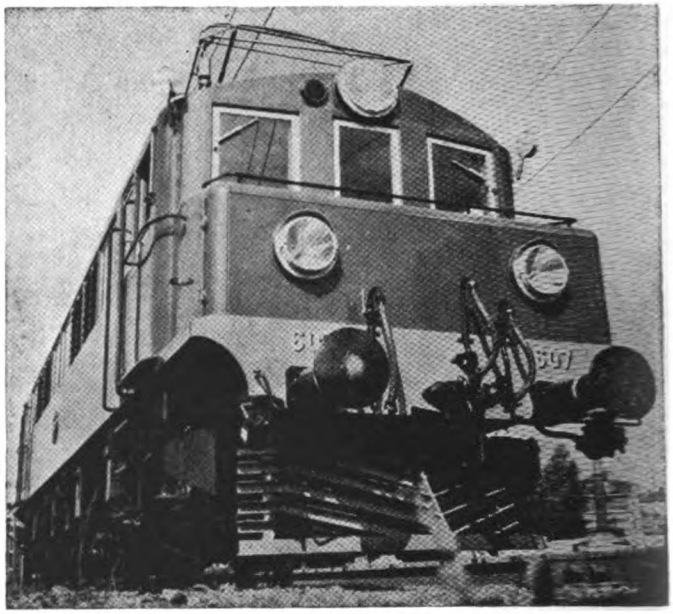
When a train is to be supplied with a. c. power, the double-throw switch is thrown up, putting a. c. power on the charging line. One of the regular charging leads is used to run from a charging receptacle to the rear of the train where a special jumper is used to make connection with the three-wire train line receptacle. The jumper is so connected that a. c. is applied to train lines No. 1 and No. 2. The third plug contact serves only to hold the loop circuit open.

With the lights in the train burning on a. c., a locomotive may be coupled to the front of the train, connections to the turbine generator made and the generator put in operation. This puts d. c. voltage between train lines No. 1 and No. 3 but there is no confusion of circuits because the loop is open at the back of the train. Before the train is ready to leave, a station electrician disconnects the jumper from the charging cable and then pulls the other end of the jumper out of the train line receptacle. The lights go out for a brief moment as the a. c. circuit is disconnected and relight immediately on direct current since pulling the plug from the train line receptacle closes the loop.

Electrified Swedish Lines Carry 86 Per Cent of Traffic

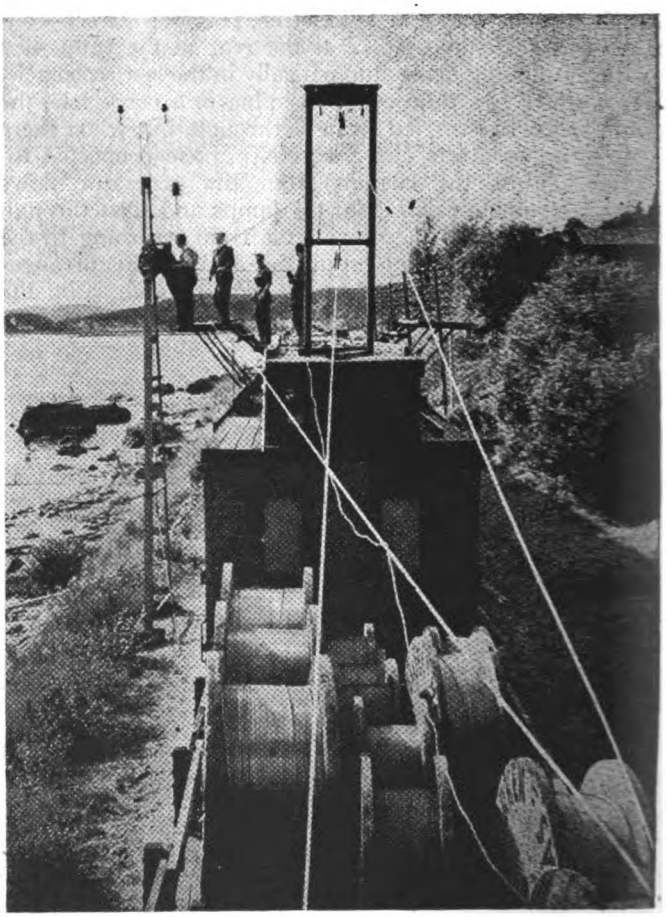
This year marks the thirtieth anniversary of the completion of the first electrified steam railway in Sweden. Coal has been a vital factor in promoting the use of hydro-electric power and it has been estimated that the electrification of the Swedish State Railways has saved 7,000,000 metric tons of coal during the war. The anniversary coincides with the inauguration of the newly electrified section between Ostersund and Jerpen in the northern province of Jemtland, which later this year will be extended up to the Norwegian border.

The Swedish State Railways, at present, operate about 6,990 miles of the country's total 10,200 miles of railway systems. Over 2,760 miles of the State lines have already been electrified and further sections are under consideration, although the shortage of materials, especially copper, has hampered activities. The rate of growth of the electrification is indicated by power consumption figures. Total power consumption in 1915 was 8,000,000 kwh., in 1925 it was 75,000,000, in 1940 it had risen to 667,000,000 and for 1945 the estimated consumption is 915,000,000.



One of the Swedish State Railway's new type M locomotives, rated 3,600 hp.

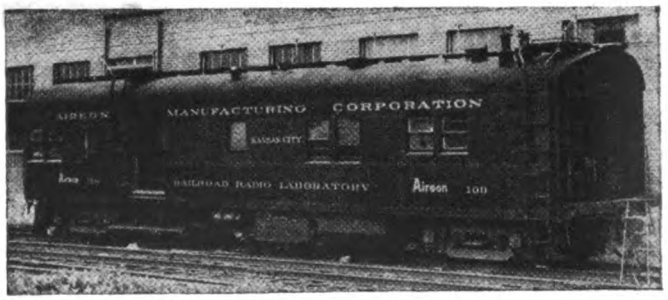
Economically the electrification has been a good investment. Compared with a cost of about $137,500,000 for the above mentioned 7,000,000 tons of coal, the cost of hydro-electrical energy has been about $22,500,000 and, deducting interest, etc., on installations amounting in all to $25,000,000, the estimated saving is about $90,000,000.



A wire train in service stringing overhead wires on Sweden's most recently electrified line

Added advantages have been derived from the fact that the electrification permits of faster and heavier trains. Scheduled operating time on the 1,213 mile run from Trelleborg in the extreme south of Sweden to Riksgransen in northernmost Lapland, has been reduced by one-third. This line was completed in 1942.

Railroad Radio Laboratory Car



The car is fitted for making tests of both space radio and carrier type train communication systems

The Aireon Manufacturing Corporation has purchased and equipped a special railroad car to be used in the demonstration, test and installation of its railroad radio telephones.

Originally built for dynamometer and track inspection service, the all-steel car has been completely remodeled and equipped with ultra-high frequency "space" radio telephone units, and inductive, or "carrier" type equipment, both of which systems are manufactured by Aireon. A carpeted lounge occupies half of the car, and a galley and eight standard Pullman berths are provided so that Aireon engineers and railroad officials may travel in the car on demonstration, test and installation trips.

The car is now on its first assignment; a test installation for the Denver and Rio Grande Railroad between Grand Junction, Colorado, and Salt Lake City, Utah.

Under the supervision of Samuel W. Fordyce, general manager, railway equipment division, Aireon Mfg. Corp., the car will be made available to railroads throughout the country in connection with the demonstration, test and installation of Aireon's railroad radio telephone equipment.

CONSULTING DEPARTMENT

Cross-Arms or Secondary Racks

We are planning to rebuild our secondary distribution lines consisting of three-phase 440-volts for power and 110/220 volt three-wire, single-phase for lighting. Which would be most economical and efficient over a period of years, secondary racks or cross-arms and pins?

Racks Cheaper But Not Always Best

If the operating conditions for the three-phase 440-volt power and the 110/220-volt three-wire lighting lines were known, it might be possible to give a definite recommendation as to the most economical type of construction to use. However, without having all of the facts as, for example, the length of the spans, the size of the wires, location with respect to smoke areas, etc., it will be necessary to answer the questions by setting forth the various factors involved, and then leave it to the person who asked the question to work out his own answer for his particular case.

The largest users of secondary lines are the power and light companies that supply electrical service to industrial and residential loads. From general observation, it would seem that at least 95 per cent of all of their secondary lines are supported on racks. This would indicate that secondary racks are the most economical type of construction for them to use. Nevertheless, secondary racks installed on a railroad right-of-way have to meet different operating conditions than do secondary racks installed along a city street or a country road.

In the first place, coal smoke not only covers the small insulators used with racks but it also combines with moisture to produce sulphurous acid. Generally speaking, the operation of low voltage lines are not seriously affected by dirty insulators, but secondary racks, even though they are heavily galvanized, can not stand the corrosive action of smoke. In fact, one metallurgist went so far as to state that smoke will corrode galvanized iron faster than ungalvanized iron. This is especially true if the ungalvanized iron has been painted or protected with one of the rust-preventing compounds.

In the second place, wires that are installed across railroad tracks must have proper clearance above the top of the rails, and it is evident that wires positioned in vertical alignment will cut down the clearance as compared to wires installed on cross-arms or on the same poles. Also wires installed across tracks, even though they are owned by the railroad company, should comply with all of the rules and regulations governing such construction. It is inconsistent for a railroad company to compel power companies to follow all of the state and railroad specifications, while at the same time allowing their own electricians to install wires that do not comply with these same specifications. It is the writer's opinion that secondary rack construction can not be installed in accordance with the railroad specification requiring double cross-arms for supporting wires at the crossing span.

In the third place, it is never advisable to support bare conductors from secondary racks, but this is frequently done when cross-arms and pins are used, because there is less likelihood of horizontally positioned wires swinging together than there is of vertically spaced ones. This is an important factor when stringing wires across railroad

tracks where steam equipment is operated. The hot gases from a locomotive can ruin the weather-proofing on wires, and if a locomotive stops with the smoke stack directly under the wires it is possible for the exhaust from the engine to lift the wires. If this should happen to wires supported vertically from secondary racks, a short circuit is likely to accur.

From the foregoing it would appear that the somewhat old fashioned cross-arms and pins have a place in the construction of secondary power and light lines used for railroad service.

P. C. FREDKY

Selection Governed by Conditions

Various conditions must be considered to determine which type of installation is more suitable for a given job. Some of these conditions are: length of line to be built, number and location of services to be taken off, number of corners in the line, and clearance over buildings or tracks. It is usually best when a line is to be built or rebuilt to figure out where each pole will be set, then make a sketch approximately to scale, marking services, guys, pole heights, etc., on the sketch. This would of course not be necessary for a short straight line with few services.

The initial cost of building a line is usually less using cross-arms and pins if the line is straight. Cross-arms provide more ground clearance for a given pole height and in some instances would allow using shorter poles than would secondary racks. However, taking off services, particularly where several services come off one pole, is facilitated by using secondary racks, and corners in a line necessitate buck arms, which increases both material and labor cost.

Conditions existing around railroad shops and shop yards are ordinarily such that secondary racks are most suitable. There are usually numerous services for both lights and power sometimes coming off corner poles, in which case secondary racks are more economical and make a better looking job than cross-arms. Buildings, tracks and other shop facilities quite often make it necessary to zig-zag lines, in which case secondary racks are usually preferred.

Each type of installation has certain advantages over the other, usually, as before-mentioned, governed by conditions. Careful analysis of these conditions will usually provide the answer as to which to use.

W. L. COTTON

Good Fir Is Scarce

The question of whether to use cross-arms or secondary racks is frequently governed by the difficulty of securing a good grade of fir cross-arms. The use of fir is controlled by numerous WPB restrictions, and with the limited supply coming out of the woods the quality at present is none too good. For anything except special conditions necessitating the use of cross-arms, I would suggest secondary racks for distribution of the three-phase 440-volt and the three-wire 110/220-volt single-phase circuits.

JOHN M. DRABELLE

* * *

This group picture at the change of shift, includes the first- and second-trick shop men at the new Diesel shop of the Delaware, Lackawanna & Western at Scranton, Pa.—Also included are the supervisors and several service representatives.—The mascot, in the foreground, bears the name "Diesel"

NEWS

First Rail Apprenticeship Agreements Signed

THE first two agreements between railroad management and labor under the National Apprenticeship Program designed for the training of skilled employees in the shop crafts have been signed, Paul V. McNutt, chairman of the War Manpower Commission, announced recently. Parties to the agreements are the New York Central and the Union Pacific, and the System Federations of the Railway Employees Department, American Federation of Labor.

Crafts in which apprentices will be trained include machinist, sheetmetal worker, carman, boilermaker, blacksmith, and electrical worker. The agreements provide for joint apprenticeship committees representing management and the unions to be organized for all points where sufficient apprentices are employed to warrant them. These groups will administer local training programs. Also, a general apprenticeship committee is to be set up for each railroad system. It will recommend rules for selecting apprentices and for governing apprentices on the job and in classrooms.

Commenting on the signing of the agreements, W. M. C. Chairman McNutt said: "It is necessary that an adequate supply of competent journeymen mechanics, who are skilled in all branches of their respective trades, shall be available at all times for an industry as essential to our national economy as the railroad industry. Management and labor are to be commended for their foresight and joint action to meet this problem. These agreements, coinciding with the imminent discharge of a large number of military personnel, will be mutually advantageous to the railroads and the former service men. The railroads are in need of manpower and many service men will want to learn a trade. I am confident these agreements will do a great deal to supply the needs of both groups."

The W. M. C. announcement went on to say that the participating railroad unions have working agreements with most of the railroads, adding that the N. Y. C. and U. P. apprenticeship agreements "are expected to be patterns for similar programs for the training of craftsmen in the trades mentioned for other roads where such working agreements exist."

Canadian Roads to Explore Possibilities of Radio

THE Canadian National and Canadian Pacific have announced jointly that recent development of point-to-point land-lines, radio automatic relay systems, by the two major communications systems in the United States justifies continued research to give the Canadian public this new medium of transmission. To minimize expense and avoid duplication of frequency allocations, the two systems have agreed to act jointly in the public interest. In addition to using radio for inter-city relay links, the railways are considering its use in train-dispatching.

Should the experiments be sufficiently encouraging to warrant permanent installations, the question naturally arises as to the extent to which radio relay systems will replace the present wire lines. The railways expect that wire lines will be retained for certain classes of service, using radio where it proves better or cheaper. The first step in the plan will be experimental installations between Montreal, Que., and Ottawa, Ont., and between Ottawa and Toronto, Ont. Progress will be limited only by restrictions on the wartime use of radio and the availability of equipment.

Orders and Inquiries for Equipment Placed Since the Closing of the July Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Chicago, Milwaukee, St. Paul & Pacific[1]	5	Diesel-elec. frt.	Electro Motive
	5	Diesel-elec. pass.	Fairbanks, Morse
	20	Diesel switchers	Baldwin Loco. Wks. / American Loco. Co.
Chicago, Rock Island & Pacific[2]	4	4,050-hp. Diesel-elec. frt.	
Delaware & Hudson	5	4-6-6-4	American Loco. Co.
Minneapolis & St. Louis	4[3]	1,000-hp. Diesel-elec. switch	
	1[3]	1,350-hp. Diesel engine	
	3[6]	4,000-hp. Diesel-elec. pass.	Electro-Motive
Missouri Pacific	3[6]	2,000-hp. Diesel-elec. pass.	Electro-Motive
Northern Pacific	8	Diesel-elec.	Baldwin Loco. Wks.
	1	Diesel-elec.	American Loco. Wks.
Texas & Pacific	1[6]	4,000-hp. Diesel-elec. pass.	Electro-Motive
Western Pacific	5[4]	1,000-hp. Diesel-elec. switch	Baldwin Loco. Wks.

LOCOMOTIVE INQUIRIES

Rapid City, Black Hills & Western	1[5]	800-hp. Diesel-elec. frt.
	1[5]	1,000-hp. Diesel-elec. frt.
Virginian	5	2-8-4 frt.

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Chicago, Milwaukee, St. Paul & Pacific	500[1]	Flat	
	25[1]	Caboose	
Erie	700	50-ton box	American Car & Fdry. Co.

FREIGHT-CAR INQUIRIES

Chicago, Rock Island & Pacific	1,000	50-ton auto box
Western Maryland	40	70-ton covered hopper

PASSENGER-CAR ORDERS

Central of Georgia	10	Streamline pass.	American Car & Fdry. Co.
Missouri Pacific	28[6]	Sleepers	Pullman-Std.
	28[6]		American Car & Fdry.
Texas & Pacific	19[6]	Sleepers	Pullman-Std.
	25[6]		American Car & Fdry.

[1] Road authorized by United States States District Court at Chicago to enter into conditional sales agreements amounting to $5,908,535 for the purchase of locomotives and freight cars costing approximately $7,108,535.
[2] Road granted permission by Federal Judge William J. Campbell to purchase four Diesel-electric freight locomotives, the total cost of which will be approximately $1,344,000.
[3] Purchase authorized.
[4] Approximate cost $400,000.
[5] For use on 1- to 4½-per cent grades. Equipped with pilots at both ends.
[6] Equipment ordered jointly by the Missouri Pacific and the Texas & Pacific for overnight service between St. Louis, Mo., and Dallas, Tex., Fort Worth, and Houston. Delivery of cars expected late in 1946. All passenger-carrying cars will have low-alloy, high-tensile and steel underframes with superstructures of aluminum alloy. Mail, baggage and express cars to be of low-alloy high-tensile steel throughout.

Miscellaneous Publications

"YESTERDAY'S IRON HORSES."—Union Steel Castings, Division of Blaw-Knox Co., Pittsburgh, Pa. "Yesterday's Iron Horses—1829-1900" presents in a book, plastic bound for easy removal for framing, illustrations of several representative locomotives from a collection of "old timers" by Ed. Alexander.

STEELWAYS.—The American Iron & Steel Institute, 350 Fifth Avenue, New York 1. "Steelways," a 9-in. by 12-in. publication to be issued quarterly for the purpose of telling in picture and print some of the many ways in which steel serves to better the lives of people at home and in industry. Vol. 1, No. 1, issued in May, 1945.

Clyde Williams Honored at Case School

IN tribute to his leadership in advancing industrial science, Clyde Williams, director of Battelle Memorial Institute, Columbus, Ohio, was presented the degree of Doctor of Science at recent convocation ceremonies of the Case School of Applied Science, Cleveland, Ohio.

The degree was presented by Dr. William E. Wickenden, president of Case, who cited Mr. Williams' accomplishments in research administration and in directing

the activities of the War Metallurgy Committee of the National Academy of Sciences and the National Research Council.

English Engineers Honor Two More Americans

E. G. BAILEY, a vice-president of the Babcock & Wilcox Company, New York, and Jerome C. Hunsaker, head of the department of Mechanical Engineering, Massachusetts Institute of Technology, have been elected honorary members of The Institution of Mechanical Engineers in England. The total honorary membership of the Institution is now 29, six of whom are Americans. The four other Americans are Henry Ford (1939), Prof. A. G. Christie of Johns Hopkins University (1939), Orville Wright (1942), and Dr. Harvey N. Davis, president, Stevens Institute of Technology (1944).

J. D. Ritchie Research Chief of Plywood Association

JOHN D. RITCHIE, chief inspector of the Douglas Fir Plywood Association, has been promoted to chief of the research department, with headquarters as before at Tacoma, Wash., succeeding J. D. Long, who is resuming his previous agricultural and educational work. George M. Williams has been appointed chief inspector, replacing Mr. Ritchie.

Supply Trade Notes

GENERAL STEEL CASTINGS CORPORATION. —*Charles P. Whitehead,* vice-president, has been elected president of the General Steel Castings Corporation to succeed Harrison Hoblitzelle, who has resigned because of ill health and who has been elected chairman of the board. *G. Fred Driemeyer,* manager of sales, has been elected vice-president in charge of sales; *George L. Alston* secretary and treasurer, has been elected vice-president and will continue as secretary and treasurer and *William M. Sheehan,* assistant vice-president, has been elected vice-president.

James MacDonald, since 1939 assistant to the vice-president—sales, of the General Steel Castings Corporation, has been appointed assistant vice-president. Before

H. Hoblitzelle

joining General Steel Castings, Mr. MacDonald was in the employ of the Baldwin Locomotive Works between 1931 and 1939 as assistant secretary, purchasing agent and assistant director of sales. *Howard F. Park, Jr.,* general purchasing agent since 1942, succeeds Mr. MacDonald as assistant to the vice-president—sales. Mr. Park formerly was associated with the Edward G. Budd Manufacturing Company. *Earl S. Howard* will assume the duties of general purchasing agent in addition to his present position as general mechanical superintendent. Mr. Howard previously was works manager of the Eddystone, Pa., plant and of the Madison, Ill., armor plant.

Charles P. Whitehead was born in Bastrop, Tex., the son of C. N. Whitehead who was president of the Missouri-Kansas-

C. P. Whitehead

Texas at the time of his death in 1926. He is a graduate of Culver Military Academy (1917) and served in the United States Navy during the last world war. He joined the Commonwealth Steel Company in 1919 and was employed in the engineering and manufacturing departments. He was transferred to the sales department in 1922, handling the western railroads. He was appointed sales assistant to the vice-president and general manager of the General Steel Castings Corporation in 1929 with headquarters at Granite City, Ill. He was moved to Eddystone, Pa., as manager of sales of the company in 1931 and promoted to vice-president in charge of sales in 1938. He served as consultant to the chief of the transportation equipment branch of the War Production Board during 1942. He was appointed vice-president in charge of manufacture, engineering and sales in 1943 and elected a director of the company in 1944. Mr. Whitehead is a member of the railroad industry, railroad locomotive specialty industry and steel castings industry advisory committees of the War Production Board.

Harrison Hoblitzelle is a graduate of Cornell University (1917). After occupy-

G. F. Driemeyer

ing a number of positions with the Commonwealth Steel Company, he was appointed vice-president and general manager of the Commonwealth division of the General Steel Castings Corporation in August, 1929. He was appointed executive vice-president with headquarters at Eddystone, Pa., in June, 1931, and elected president in September, 1931. Mr. Hoblitzelle is a member of the board of governors of the Railway Business Association.

G. Fred Driemeyer is a graduate of the Washington University Engineering School. He joined the Commonwealth Steel Company's engineering department in 1919. After serving in various capacities, he was sent to Australia in 1927 and 1929 and to Paris in 1930 as European manager for the company. He represented General Steel Castings in the Chicago district from 1931 to 1939. He was appointed assistant works manager of the Commonwealth plant in 1939 and promoted to works manager in July, 1941. He was appointed manager of

Army-Navy "E" Awards

American Car & Foundry Co., Wilmington, Del., shipyard. Fifth renewal.

Babcock & Wilcox Co., Bayonne, N. J. Renewal.

Bendix Aviation Corporation, Bendix Radio division. Fourth award.

Davenport-Besler Corporation, Davenport, Iowa. Third renewal.

Independent Pneumatic Tool Company, Aurora, Ill. Fifth award.

McKay Company, McKees Rocks, Pa. Fifth renewal.

Pullman-Standard Car Manufacturing Company, Hammond, Inc. Fourth award.

ales with headquarters at Eddystone, Pa., September, 1941.

George L. Alston joined the American Steel Foundries, Chicago, in 1906, and continued with that company until 1925. From then until the formation of the General Steel Castings Corporation he was associated with the Birdsboro Steel Foundry &

G. L. Alston

Machine Co., Birdsboro, Pa. He has been secretary and treasurer of General Steel Castings Corporation since its organization. He is a member of the advisory committee for the steel castings industry to the Office of Price Administration.

William M. Sheehan was educated in St. Andrew School, Roanoke, Va., and at St. Louis University. He completed an apprenticeship as a machinist on the Norfolk & Western and later served in the engineering

W. M. Sheehan

departments of that road, the Erie and the American Locomotive Company. He joined the Commonwealth Steel Company in 1913 and has served continuously since that time in the engineering and sales departments of Commonwealth Steel and its successor, General Steel Castings. He was appointed assistant vice-president, sales in 1939 and assistant vice-president in 1944. He is active in the American Society of Mechanical Engineers, and is chairman of the Executive Committee of the Railroad Division.

◆

H. K. Porter Company, Inc.—The offices of the Porter Company in Rochester, N. Y. have been removed to headquarters in the Walbridge Building, Buffalo, N. Y. *W. A. Coyle* has been appointed district manager in charge of sales for Porter and Devine process equipment. He will also handle sales for Quimby Pumps and Fort Pitt Steel Castings in the territory. Mr. Coyle, who for the past ten years had been assistant combustion engineer of the Republic Steel Corporation in Buffalo, received his B. S. E. E. degree at Clarkson University of Technology and his master's degree at Lehigh University. He is a member of the Engineering Society of Buffalo, and of the Iron and Steel Engineers Society.

◆

United States Plywood Corporation.—The United States Plywood Corporation has moved its executive offices in New York to 55 West Forty-fourth street.

◆

National Malleable & Steel Castings Company.—*John F. Hutson* has been appointed district sales manager, Chicago territory, including Omaha, Neb., St. Paul, Minneapolis, and Duluth, Minn., for the National Malleable & Steel Castings Company, to succeed *Tom W. Aishton*, who has retired because of ill health. Mr. Hutson has been with National Malleable since 1919, serving in Cleveland, Ohio, Washington, D. C., and Chicago. Since 1936 he has been sales agent at the Chicago railway

John F. Hutson

sales office. *Frank E. Moffett* has been appointed to the newly created position of assistant district sales manager for the Chicago territory. Mr. Moffett joined National Malleable in 1908 as a draftsman at the Chicago Melrose Park works. In 1919 he was appointed plant and safety engineer at the Cleveland works. He returned to Chicago in 1924 as service engineer in railway sales and in 1930 became sales agent. *Edward O. Warner*, for many years Philadelphia, Pa., district sales manager for the National Malleable & Steel Castings Co., has retired from active duty. *Russell J. Wittmer* succeeds Mr. Warner as Philadelphia district sales manager, *William M. Blackmore* has been appointed southeastern district sales manager.

Edward O. Warner is a graduate of Lehigh University (1894) with a degree in electrical engineering. He was employed by the Hartford, Conn., Street Railway Company and from 1896 to 1898 by the Pennsylvania. He joined the Latrobe Steel & Coupler Co. in 1898 and was placed in charge of the Philadelphia office in 1902. When Latrobe was acquired by National Malleable in 1909, he was appointed Philadelphia sales agent and district sales manager.

Russell J. Wittmer was born in Waterloo, Ind., in 1895. He served in World War I and is a graduate of the Case School of Applied Science, Cleveland (1920). He

Frank E. Moffett

has been associated with the National Malleable and Steel Castings Company since his graduation. In 1923 he was sent to Europe on an engineering assignment, and since 1941 has been in the railway sales division. Prior to his assignment to the Philadelphia district he was sales agent in the southeastern territory, with headquarters in Washington, D. C.

William M. Blackmore was born in Cleveland. He entered the engineering department of the company in 1906 and was later assigned to the inspection and test

Edward O. Warner

department. In 1913 he became chief engineer and in 1919 was appointed assistant superintendent of the steel-castings plant at Sharon, Pa. He returned to the engineering department in 1931 and, prior to his appointment as southeastern district sales manager, was in the general office, engineering department, at Cleveland, where he worked on the development of railroad specialties.

MOUNT VERNON CAR MANUFACTURING COMPANY.—*William J. Roehl, Inc.*, St. Louis, Mo., have been appointed freight-car-sales agents in the St. Louis district for the Mount Vernon Car Manufacturing Company, a division of the H. K. Porter Company of Pittsburgh, Pa.

◆

DAVIS BRAKE BEAM COMPANY.—*Roy H. Weber*, San Francisco, Calif., has been appointed west coast representative of the Davis Brake Beam Company.

◆

AMERICAN LOCOMOTIVE COMPANY.—*Gus H. Sample* has been appointed technical assistant to the director of engineering, Diesel division of the American Locomotive Company with headquarters at Schenectady, N. Y. Mr. Sample is a graduate of Washington University, with a degree in mechanical engineering, and is a member of the advisory board of that university's Engineering school. He was draftsman and designing engineer with the Busch Sulzer Company at St. Louis, Mo., from 1930 to 1932 and installed and operated

Gus H. Sample

Diesel engines on large dredging operations from 1932 to 1934. He was sent to the Diesel engine plant of Fairbanks, Morse & Company in Beloit, Wis., in December, 1934, working for the U. S. Navy bureau of engineering as senior inspector, and later as associate mechanical engineer in charge of Navy inspectors in this plant. He resigned from the bureau of engineering in 1937 and returned to the Busch Sulzer organization in St. Louis as executive engineer in charge of engineering in connection with installations for the Maritime Commission and various naval vessels. He also was assistant to the general manager of the plant with jurisdiction over all inspection and engineering, which position he held until his appointment as technical assistant to the director of engineering, Diesel division, American Locomotive Company.

◆

R. K. LEBLOND MACHINE TOOL COMPANY.—*Lester H. Roemer*, for the past few years assistant sales manager of The R. K. LeBlond Machine Tool Company, Cincinnati, Ohio, has assumed the duties of New York District Manager for the company, with headquarters in the Singer Building, 149 Broadway, New York. Mr. Roemer has been with LeBlond twenty-three years, during which time, prior to his work as assistant sales manager, he worked through the various shop departments and on the road as service man and demonstrator in both the United States and Europe, as well as spending approximately ten years in the sales department on estimating and general sales work.

L. H. Roemer

◆

THE EDWARD G. BUDD MANUFACTURING COMPANY has leased, and arranged to transfer its railway passenger-car manufacturing division to a government-owned plant at Bustleton, Pa., in the Philadelphia area. The property is now operated by the Budd Company under a Reconstruction Finance Corporation war-plant facilities lease, sponsored by the Navy Department.

Terms of the lease, which runs for five years, provide that 77 per cent of the space ultimately will be used for car building. A substantial portion of this is presently used in the manufacture of munitions. The company has indicated that it may utilize the remaining 23 per cent, which now is used as a disposal center for surplus property, once production is fully under way on non-war contracts. The war-plant lease is reported to be the largest negotiated to date for the purpose of providing space for peacetime production while work is going ahead on war contracts. Construction of the first railway cars is expected to get under way in the fall.

The new plant comprises a main assembly and manufacturing building covering 24½-acres and an administration building and power plant, with railway sidings running directly into the main building. The manufacturing building has six bays. Two main bays, each 1,800 ft. long and 122 ft. wide, will permit the assembling of 80 cars in four lines at one time. Sub-assembly lines and parts fabricating facilities adjoin the main assembly lines.

The administration building contains 45,000 sq. ft. of floor space on two floors and houses administrative offices, personnel offices, medical department, restaurant, and central telephone exchange. Electric power current for the plant, obtained at 66,000 volts, is stepped down at the main sub-station to 13,200 volts and transmitted at this voltage to indoor sub-stations from which it is distributed at 440 volts. Feeders are carried in underground ducts. There are power stands in each column of the two main bays, and a tunnel extends almost the entire length of each bay. Services are drawn from these tunnels by movable stands which straddle the tunnels. Each stand is equipped with compressed-air outlets, water supply, welding power and 440-volt, 110-volt and high-cycle power.

◆

HUNT-SPILLER MANUFACTURING COMPANY.—*Dan F. Hall* has been appointed western sales manager of the Hunt-Spiller Manufacturing Corporation, Boston Mass. Mr. Hall served his apprenticeship as a machinist in the Dubuque, Iowa, shops of the Chicago, Milwaukee, St. Paul & Pacific. He was in the air service in the last world war, after which he returned to the Milwaukee and was employed as enginehouse foreman at Ottumwa, Iowa, until 1923. He was appointed sales and service engineer

Dan F. Hall

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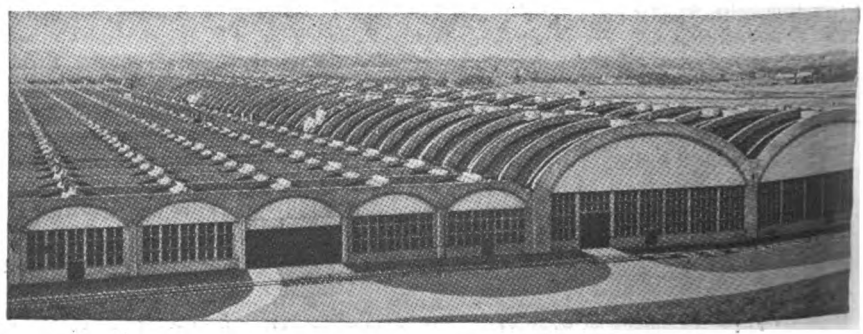


Plant at Bustleton, Pa., leased by the Edward G. Budd Manufacturing Company—The two main bays at the right will house four lines for assembling 80 passenger cars at one time.

3 AIMS HAVE BECOME ACCOMPLISHMENTS

When the Association of Manufacturers of Chilled Car Wheels adopted Association inspection, a threefold purpose was announced. It was "uniform specifications and uniform product in addition to uniform inspection". Each of these has been translated into an accomplished fact, thanks to the Association's insistence on high product quality as an essential condition of membership.

The same specifications are part of the code of practice to which every member manufacturer must adhere. The same increasingly high inspection standards are applied equally to the wheels of every member company. Seven rigid tests impartially and thoroughly carried out help to assure product uniformity.

AMCCW

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE, NEW YORK 17, N. Y. • 445 NORTH SACRAMENTO BOULEVARD, CHICAGO 12, ILL.

Organized To Achieve: Uniform Specifications — Uniform Inspection — Uniform Product

4146

for the Stover Manufacturing & Engine Co., Freeport, Ill. in 1924, serving in that capacity until January, 1928. He joined the Hunt-Spiller Manufacturing Corporation in February, 1928, as representative in the northwestern territory.

◆

ELECTRIC SERVICE MANUFACTURING COMPANY.—*Hoffman Engineering*, 313 South Second Street, Albuquerque, N. M., has been appointed exclusive agent for all products of the Electric Service Manufacturing Company in the states of Arizona and New Mexico.

◆

MALABAR MACHINE COMPANY.—The Malabar Machine Company, Los Angeles, Calif., has appointed Standard Car Sales, Inc., Chicago, its railroad representative for all railroads having sales or mechanical offices in the Chicago territory.

◆

KELITE PRODUCTS, INC.—Kelite Products, Inc., manufacturer of industrial chemicals for cleaning and processing, has moved its southwestern headquarters from Houston, Tex., to its new factory at Dallas, Tex. *F. L. Alexander* has been appointed assistant national director with supervision over the Dallas plant as well as all regional offices in the southwestern division.

◆

CONTINENTAL OIL COMPANY.—*Joseph M. Gambill*, for the past 15 years railroad lubricating engineer for the Continental Oil Company, has retired.

◆

GENERAL AMERICAN TRANSPORTATION COMPANY.—The General American Transportation Corporation has completed negotiations for the acquisition of the Eclipse Moulded Products Company of Milwaukee, Wis., manufacturers and distributors of plastic products, which will be operated under the same management.

◆

BALDWIN LOCOMOTIVE WORKS.—*D. C. Prescott* has been appointed to the sales staff of the Baldwin Locomotive Works for the north central district, with head-

D. C. Prescott

quarters in Chicago. Mr. Prescott formerly was mechanical engineer of the Union Pacific at Omaha. He is a graduate of Idaho University with a degree in mechanical engineering and was employed with a number of leading manufacturers prior to joining the Union Pacific in 1936.

Edward H. Schoonmaker, of Syracuse, N. Y., has been appointed sales engineer for the southwestern district office of the

Edward H. Schoonmaker

Baldwin Locomotive Works. Mr. Schoonmaker attended Fenn College at Cleveland, Ohio. He was employed with the Erickson Steel Company at Cleveland and Philadelphia, Pa., prior to joining Baldwin last November as a Diesel service engineer. He had served as a maintenance officer for an armored division at Fort Smith, Ark., and was honorably discharged in March, 1944, after two years of military service.

◆

FIRTH-STERLING STEEL COMPANY.—*George W. Frick* has been appointed general sales manager and *A. R. Zapp* carbide

G. W. Frick

products manager of the Firth-Sterling Steel Company.

George W. Frick has been identified with the metal-working industries in various capacities since 1913. After serving more than two years with the Marines in World War I, he became a sales engineer of tool and die steels. As a special representative of Crucible Steel Company of America for five years, he promoted nationally the use of alloy steels and stainless steels. In 1929 he joined Firth-Sterling, and was appointed manager of the Ohio Division in 1930, serving in that capacity until 1941, when he was moved to McKeesport as manager of the Firthrite division, having charge of the development and marketing of sintered carbide for cutting tools both in this country and for export.

A. R. Zapp, an officer in the Navy in the first World War, received advanced engineering training at Stevens Institute of Technology and Annapolis. While associated with Union Wire Die Company he participated in the evolution and development of sintered carbide dies. Mr. Zapp was appointed manager of Firth-Sterling's Firthaloy division in 1932. In cooperation with the Industry Committee on Steel Car-

A. R. Zapp

tridge Cases, he is credited with contributing to the development of special dies for brass and steel cartridge case manufacturing.

◆

WESTINGHOUSE ELECTRIC CORPORATION.—*Harry L. Huntley* has been appointed headquarters repair sales manager of the thirty-four plants of the manufacturing and repair department of the Westinghouse Electric Corporation with headquarters in Pittsburgh, Pa. Mr. Huntley is a graduate of the Bliss Electrical School, Washington, D. C., with a degree in electrical engineering (1922). He joined Westinghouse in 1926 in service engineering and sales work in the service department at Philadelphia, Pa. He opened the service shop at Wilkes-Barre, Pa., in 1927, and remained there as manager until 1939, when he was transferred to Fairmont, W. Va. to open and manage the manufacturing and repair plant. He was transferred to Pittsburgh in 1940 to organize and manage the repair and renewal parts sales division for the central district, in which capacity he served until his new appointment.

◆

OLD DOMINION IRON & STEEL CORP.—The Old Dominion Iron & Steel Corp. has been newly chartered to acquire all physical properties of the Old Dominion Iron & Steel Works, Inc., Belle Isle, Richmond, Va., for the manufacture of welded steel products. The new officers include *G. E. Hoppe, Jr.*, president; *A. A. Adcock*, vice-president and *R. A. Trombold*, secretary-treasurer. All were formerly with the Richmond Engineering Company. Present operations, which have been on a limited scale for several years, will be continued while buildings and equipment are being made ready for the new product. All per-

(*Continued on next left-hand page*)

MIGHTIER POWER *for tomorrow*

AMONG the many improvements in railroad transportation in recent years, unquestionably the most outstanding is the greatly increased speed in the movement of heavy freight.

This has been made possible through greatly increased efficiency in motive power, as is exemplified in the operation of Lima Locomotives.

Fleets of these locomotives, now playing a vital role in wartime service, will be ready to meet tomorrow's demands to haul heavier trains, at higher speeds, and at lower costs.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

sonnel will be retained, including *R. H. Wayt*, vice-president and general manager of the old corporation, and *John C. Webb*, superintendent of the rolling mills.

◆

AMERICAN SEATING COMPANY.—*Hugh G. Bersie* has been appointed product manager of the American Seating Company's transportation seating division to succeed O. M. Dunton. During the past six months, Mr. Bersie has been making special studies in the transportation field as a member of the company's research department. Mr. Dunton will continue with special contacts among coach builders.

◆

H. K. PORTER COMPANY.—*Harold L. Kennedy* has been appointed district sales manager of the H. K. Porter Company of Pittsburgh, Pa., with headquarters in a new office established by the company at 513 Colorado building, Washington, D. C. He will handle sales for Porter locomotives and Mount Vernon freight cars and also will be in charge of the distribution of other Porter products. Excepting for service as a captain in the U. S. Army Air Corps during 1942 and 1943, Mr. Kennedy has been employed since 1922 in the railroad transportation department of the Fruit Growers Express Company, Washington, most recently as assistant purchasing agent.

◆

ASHTON SALVAGE COMPANY.—*J. W. Motherwell*, president and treasurer, has been elected chairman of the board of the Ashton Valve Company to succeed *Ellery Peabody*, president of the company for the past 35 years and chairman of the board for the past two years, who is retiring at his own request. *William P. Husband, Jr.*, formerly commissioner of banks of Massachusetts, has been elected president and treasurer.

◆

WILSON WELDER & METALS COMPANY.—The *Graybar Electric Company* has been appointed exclusive distributor of the Wilson Welder & Metal Co.'s brand of electrodes in areas served by Graybar's Cincinnati and Cleveland, Ohio, and Pittsburgh, Pa., offices.

◆

CARNEGIE-ILLINOIS STEEL CORPORATION.—*Albert F. Steubing* has been appointed assistant to the manager of sales, high strength steel division, of the Carnegie-Illinois Steel Corporation. Mr. Steubing joined the United States Steel Corporation in New York in 1934. He was transferred to the Carnegie-Illinois organization in 1938 where he has served as development engineer in the market development division of the sales department. Mr. Steubing was formerly in the employ of the Pennsylvania and the Chicago, Rock Island & Pacific.

◆

THOMAS MACHINE MANUFACTURING COMPANY.—The Thomas Machine Manufacturing Company, Pittsburgh, Pa., has announced the appointment of sales agencies for 10 cities, completing its sales network for the United States. The new agents are the Northern Machinery & Supply Co., Minneapolis, Minn.; Richard Ives Co., Denver, Colo.; J. M. Grisley, Salt Lake City, Utah; Dawson Machinery Co., Seattle, Wash.; Harron, Richard & McCone Co., San Francisco and Los Angeles, Cal.; C. J. Harter Machinery Co., Houston and Dallas, Tex.; Robert R. Stephens Machinery Co., St. Louis, Mo.; George E. Zweifel & Co., Portland, Ore.; Bryant Machinery & Engineering Co., Milwaukee, Wis., and the Roland Company, Nashville Tenn.

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*R. M. Fox* has been appointed manager of works of the Pullman-Standard Car Manufacturing Company plant at Butler, Pa.

◆

UNITED STATES STEEL CORPORATION.—*David F. Austin*, vice-president in charge of sales of the Carnegie-Illinois Steel Corporation, has been appointed acting vice-president, sales, or the United States Steel Corporation. *Avery C. Adams*, vice-president, sales, has resigned.

◆

CUTLER-HAMMER, INC.—*F. R. Bacon* has been elected chairman of the board of directors of Cutler-Hammer, Inc.; *H. F. Vogt*, chairman of the Executive Committee and vice-president and treasurer; *G. S. Crane*, president; *J. C. Wilson*, vice-president and secretary; *P. B. Harwood*, vice-president in charge of engineering, and *P. S. Jones*, vice-president in charge of sales.

◆

ALLEGHENY LUDLUM STEEL CORPORATION.—The Allegheny Ludlum Steel Corporation, Brackenridge, Pa., has available, for use upon request, a new 16-mm. sound and color film entitled "The Manufacture of Dies." The film has a running time of 10 min. It describes the manufacture of lamination dies from Huron high-carbon high-chromium die steel, supplementing others already available covering stainless, tool, and electrical steels.

◆

Spring Makers Named in an Anti-Trust Suit

A CIVIL suit charging 10 manufacturers, a patent holding company, and the Railway & Industrial Spring Association with conspiracy to suppress competition in the manufacture and sale of railway springs and spring plates, in violation of the Sherman Anti-trust Act, was filed June 20 by the Department of Justice in the federal district court at Hammond, Ind., according to Attorney General Biddle.

The defendants named in the suit, in addition to the trade association are: American Locomotive Company, New York; American Spiral Spring & Manufacturing Company, Pittsburgh, Pa.; American Steel Foundries, Hammond, Ind.; Baldwin Locomotive Works, Eddystone, Pa.; Crucible Steel Company of America, New York; Fort Pitt Spring Company, McKees Rocks, Pa.; Pittsburgh Spring & Steel Company, Pittsburgh; Union Spring & Manufacturing Company, New Kensington, Pa.; Symington-Gould Corporation, Rochester, N. Y.; Universal Railway Devices Company, Chicago; and Pittsburgh Steel Foundry Corporation, Glassport, Pa.

Obituary

MYRON J. CZARNIECKI, vice-president in charge of sales for the A. M. Byers Company, died on June 18. Mr. Czarniecki was 53 years of age. He joined the Byers organization in 1913 and was appointed manager of the company's Chicago sales office in 1919. He was transferred to New York in 1920 and managed that office until he was returned to Pittsburgh in 1925 as assistant general manager of sales. He was advanced to general manager of sales

M. J. Czarniecki

in 1930 and elected vice-president in charge of sales in 1934. He was a member of the American Iron & Steel Institute, the American Petroleum Institute, the American Supply & Machinery Manufacturers Association, the Railway Business Association, the Engineers Society of Western Pennsylvania, and other civic associations.

◆

SAMUEL A. SPALDING, vice-president and chief engineer of Gibbs & Hill, Inc., consulting engineers, New York, died May 25 at his home in New Canaan, Conn. Mr. Spalding was 72 years of age. He was a graduate of Tufts College with a degree in electrical engineering in 1894. He began his career with the Brooklyn Rapid Transit

Samuel A. Spalding

Company and later joined the staff of the engineer of electric traction of the New York Central in connection with the electrification from New York to Harmon.

(*Continued on next left-hand page*)

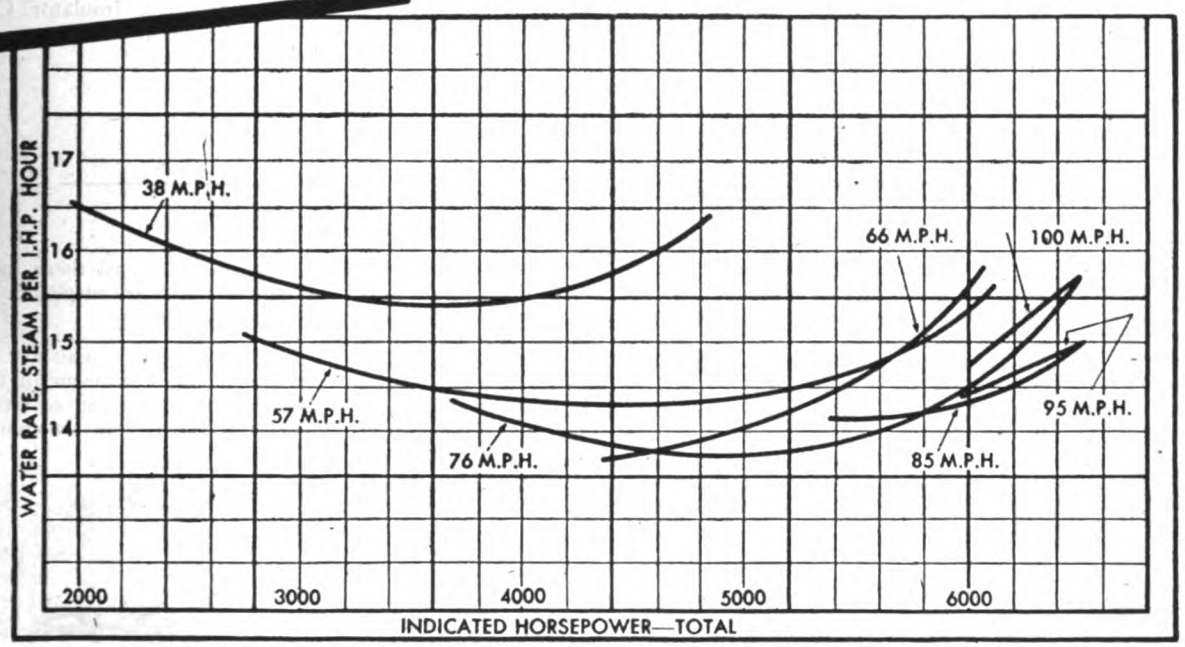
STEAM PER HORSEPOWER HOUR

The Franklin System of Steam Distribution

applied to

The Pennsylvania Railroad's

T-1 Locomotives



IN a paper read before the New York Railroad Club on May 17, 1945, describing the Pennsylvania Railroad's T-1 Locomotive, Chief Engineer Ralph P. Johnson of the Baldwin Locomotive works stated:

"The minimum water rate was 13.6 pounds at a speed of 76 miles per hour and 20 percent cut-off. In most of the tests the water rate was between 14 and 15.5 pounds.

"In 40 years of testing on the Altoona Test Plant, this locomotive gave the lowest water rate."

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO

In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

He became superintendent of power of the Brooklyn Rapid Transit and in 1908 joined the staff of the chief engineer, electric traction and station construction of the Pennsylvania, under George Gibbs and E. R. Hill, with whom he continued when they were later incorporated as Gibbs & Hill, Inc. He specialized in power-house design and was appointed chief engineer of the firm, which has handled a large portion of this country's electrification, including the Pennsylvania's original electrification from Long Island City and New York to Manhattan transfer and Philadelphia suburban; the Norfolk & Western's Elkhorn grade; the Virginian over the Alleghenies from Mullens to Roanoke, Va.; the Illinois Central's Chicago suburban; the New York Connecting Railroad's Bay Ridge; the Pennsylvania's through electrification from New York to Washington and Harrisburg, Pa. and extensions on the New York, New Haven & Hartford. During the second world war he was active as chief engineer in the design and construction of work connected with the war effort.

◆

JOHN B. STRAUCH, who was chairman of the board of the National Bearing Metals Corporation, until last January when the firm became the National Bearing Division of the American Brake Shoe Company, died at St. Louis, Mo., on June 22.

◆

H. J. TIERNEY, president of the H. J. Tierney Supply Co., St. Louis, Mo., died on June 10. Mr. Tierney was born at Junction City, Kan., on July 14, 1871, and entered railway service with the Missouri-Kansas-Texas on March 4, 1887, as a machinist, later serving as chief draftsman. Some time later he was appointed mechanical engineer and superintendent of the car department. In 1918, Mr. Tierney entered the railway supply business which he operated up to the time of his death.

◆

CARL F. HANSON, chief consulting engineer of the Irvington Varnish & Insulator Company, passed away at his home in Westfield on April 27, 1945, after a brief illness. Mr. Hanson received his B. S. and M. S. degrees in electrical engineering at the University of Kansas. He was a member of The American Society for Testing Materials and The National Research Council. He became associated with Irvington Varnish & Insulator Company in 1930 as a technical director.

Personal Mention

FRANK S. ROBBINS, whose retirement as general superintendent motive power of the Atlantic Coast Line at Wilmington, N. C., was announced in the July issue, was born at Menantico, N. J., on December 22, 1880. He attended Newark Technical School and Purdue University, from which he received his B. S. degree in mechanical engineering

Frank S. Robbins

in 1906. He entered railroading in 1900 as a machinist apprentice in the service of the Pennsylvania, and from 1906 to 1907 served as a special apprentice in the Altoona shops. From 1907 to 1908 he was on special duty, and in 1909 became motive-power inspector at Renovo, Pa. In 1910 Mr. Robbins was appointed assistant master mechanic of the Monongahela division; in 1911, assistant road foreman of engines, Renovo division; in 1913, assistant general foreman of the Pitcairn shops, and in 1914 assistant master mechanic of the Pittsburgh division. After serving in the United States Army, Engineer Officers Reserve Corps, from 1916 to 1918, during which time he rose to the rank of major, Mr. Robbins returned to the position of assistant master mechanic of the Pittsburgh division, and in 1919 became master mechanic. In 1921 Mr. Robbins left the Pennsylvania and joined the Inter-allied Technical Board, Trans-Siberian Railways, at Harbin, China, as mechanical adviser. In 1923 he was named railway representative of the Pittsburgh Testing Laboratory. He served as superintendent, motive power and machinery, of the Florida East Coast at St. Augustine, Fla., from 1926 to 1937, when he was appointed general superintendent motive power of the Atlantic Coast Line at Wilmington.

HAROLD C. WRIGHT, whose appointment as superintendent of motive power of the Pennsylvania's Eastern Ohio division, with headquarters at Pittsburgh, Pa., was announced in the June issue, was born at Altoona, Pa. After graduating from Pennsylvania State College he entered railroading as a storehouse attendant in the employ of the Pennsylvania at Altoona in 1911. In 1921 he was advanced to the position of motive power inspector, and three years later became gang foreman at Olean, N. Y.

Harold C. Wright

Mr. Wright was appointed assistant master mechanic of the Pittsburgh division in 1935, and, following service on several other divisions, master mechanic of the Williamsport division in 1940. He transferred to Altoona in 1942 and remained there until his appointment as superintendent of motive power at Pittsburgh.

LOUIS E. LAURENT, assistant engineer of the mechanical department of the Erie at Cleveland, Ohio, has retired after 28 years of service. Mr. Laurent was born in Paris,

L. E. Laurent

France, on June 30, 1874. He received his engineering education at New York City College and Princeton University, and before joining the Erie in 1917, worked as a mining engineer in Mexico for several years. His career with the Erie began as an inspector in the engineering department. He subsequently became assistant engineer in the engineering and mechanical departments.

O. HOMER BRYAN, locomotive engineman on the Western division of the Western Pacific, has been appointed assistant to the general manager, with headquarters at San Francisco, Calif.

E. L. BANION, general foreman of the Atchison, Topeka & Santa Fe at Needles, Cal., has been appointed assistant division superintendent, with the same headquarters.

(*Turn to second left-hand page*)

IT'S A GREAT NEW DAY FOR RAILROADING

Eight

General Motors Diesel

passenger locomotives

on the L & N

were assigned a total of

1,519,973 miles

for 1944.

They actually operated

a total of 1,494,924 miles

or 98.4% of their assignment.

That's an average of

126,664 miles per month;

averaging 15,833 miles

per locomotive.

ON TO FINAL VICTORY ★ BUY MORE WAR BONDS

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS CORPORATION LA GRANGE, ILL.

ANGUS HUGH WILLIAMS, general supervisor of apprentice training of the Canadian National system, with headquarters at Montreal, Que., has retired on pension after more than 38 years of service. Mr. Williams was born at Goldensville, N. S., on June 29, 1880, and after serving for seven years with the Blue Nose Gold Mining Co., and working as a fitter and later as a

A. H. Williams

machinist in the employ of the Dominion Iron & Steel Co. he joined the Canadian Northern (now the Canadian National) as a machinist at Winnipeg in 1907. There was then no coordinated system of apprentice training, and Mr. Williams was soon allowed several hours away from his job as a machinist to help the apprentices. In 1916 he became an apprentice instructor, and five years later was appointed supervisor of apprentices. In 1930 Mr. Williams moved to Montreal as general supervisor of apprentice training for the system, and was responsible for reorganizing the training plan and setting up a uniform system to cover eleven different trades.

O. R. PENDY, general enginehouse foreman of the New York, Chicago & St. Louis at Conneaut, Ohio, has been appointed assistant chief mechanical officer, with headquarters at Cleveland, Ohio. Mr. Pendy was born at Oil City, Pa., on December 17, 1900, and is a graduate of Penn State University (1924). After graduation he entered the mechanical department of the Nickel Plate as a special apprentice. During 1927 he was a dynamometer car operator, and from 1929 to 1931 machinist and gang leader at Conneaut. In 1931 he became mechanical inspector for the superintendent of motive power at Cleveland; in 1933, fuel supervisor, and in December, 1936, general enginehouse foreman at Conneaut.

W. W. LYONS, master mechanic of the Western division of the Atchison, Topeka & Santa Fe at Dodge City, Kan., has been appointed acting mechanical superintendent of the Northern district, with headquarters at La Junta, Colo.

C. L. WILSON, superintendent motive power of the Elgin, Joliet & Eastern at Joliet, Ill., has retired after 47 years of service. Mr. Wilson was born at Joliet. He entered the service of the E. J & E. on November 25, 1897, as a machinist helper. On March 3, 1898, he became a locomotive fireman, and on January 8, 1903, locomotive engineer. He was appointed assistant train rules examiner on September 21, 1918; traveling engineer on February 1, 1919; air-brake supervisor on January 15, 1925; on August 1, 1933, master mechanic at Joliet, and in May, 1938, superintendent of motive power.

P. J. DANNEBERG, mechanical superintendent of the Northern district of the Atchison, Topeka & Santa Fe at La Junta, Colo., has beeen transferred to the Southern district, with headquarters at Amarillo Tex.

E. G. EKLUND, superintendent of motive power and rolling stock of the Rutland at Rutland, Vt., has been relieved of his duties as superintendent in order that he may devote his full time to the latter position.

J. S. THORP, electrical engineer of the Delaware, Lackawanna & Western at Hoboken, N. J., has been appointed assistant to the vice-president.

GEORGE ALEXANDER HOWARD, supervisor, accident prevention, of the Western region of the Canadian National, has been appointed general supervisor of apprentice training for the system, with headquarters at Montreal, Que. Mr. Howard was born in England on October 30, 1903, and came to Canada in 1914. He began his apprenticeship in the Canadian National's Fort Rouge shops, Winnipeg, Man., in 1920, and

C. A. Howard

served as a machinist from 1926 to 1930. Early in 1931 he was appointed apprentice instructor at Fort Rouge, transferring to Transcona, Man., in 1936. He became supervisor of apprentices, Western region, in 1939, and in 1943 was assigned to organize safety work on the Western region as supervisor, accident prevention.

NORCUM ARTHUR PEEBLES has been appointed electronic engineer of the Atlantic Coast Line with headquarters at Wilmington, N. C..

F. E. EDWARDS, assistant superintendent, electric equipment, of the New York Central at Harmon, N. Y., has been appointed superintendent, electric equipment, with headquarters at Harmon.

ANDREW B. COSTIC, assistant electrical engineer of the Delaware, Lackawanna & Western, has been appointed electrical engineer at Hoboken, N. J.

Master Mechanics and Road Foremen

W. D. QUARLES, master mechanic of the Richmond and Norfolk districts of the Atlantic Coast Line at Rocky Mount, N. C., has been appointed Diesel master mechanic for the system with headquarters at Wilmington, N. C. Mr. Quarles was born in Richmond, Va., July 11, 1892. He attended the Richmond public schools and the Virginia Mechanical Institute, where

W. D. Quarles

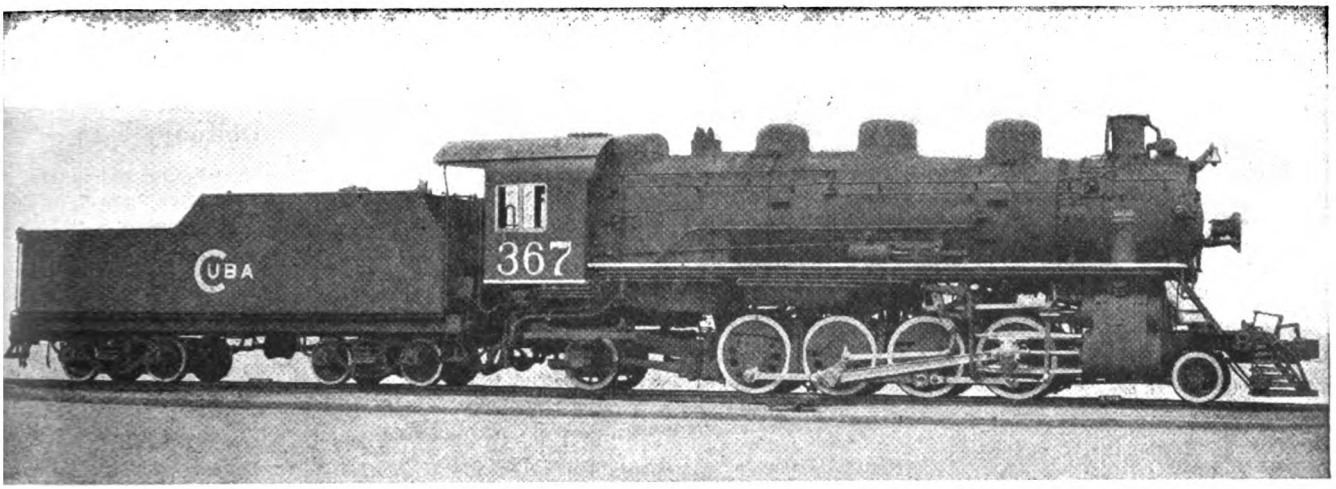
he studied electrical engineering. From 1907 to 1910, inclusive, he served an apprenticeship in the Richmond branch of the American Locomotive Works, in the electrical maintenance department. Mr. Quarles became fireman in the employ of the Atlantic Coast Line, on February 11, 1911. He became a locomotive engineer on July 16, 1917; fuel instructor between Richmond and Florence on November 1, 1918; road foreman of engines, Wilmington district, September 1, 1919; road foreman of engines, Charleston district, in January, 1933, and on December 1, 1936, road foreman of engines, Richmond district, with headquarters at Rocky Mount. On April 1, 1939, Mr. Quarles was appointed general mechanical instructor for the entire system. He became master mechanic of the Richmond and Norfolk districts on November 1, 1944, and Diesel master mechanic for the system on July 1, 1945.

J. A. PARRISH, general foreman of the Louisville & Nashville at Montgomery, Ala., has been appointed master mechanic of the Louisville Terminals and Louisville division, with headquarters at Louisville, Ky.

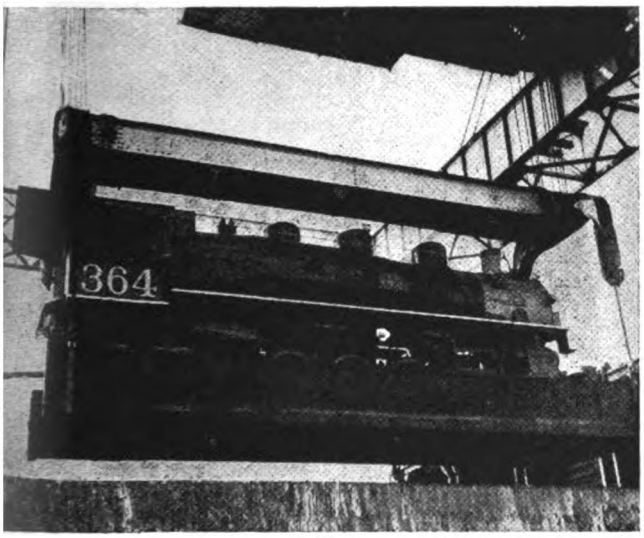
H. G. STUBBS, master mechanic of the Southern at Atlanta, Ga., has retired after 48 years of service.

G. E. ALGOE, assistant road foreman of engines of the Maryland division of the Pennsylvania, has been appointed road foreman of engines of the Toledo division, with headquarters at Toledo, Ohio.

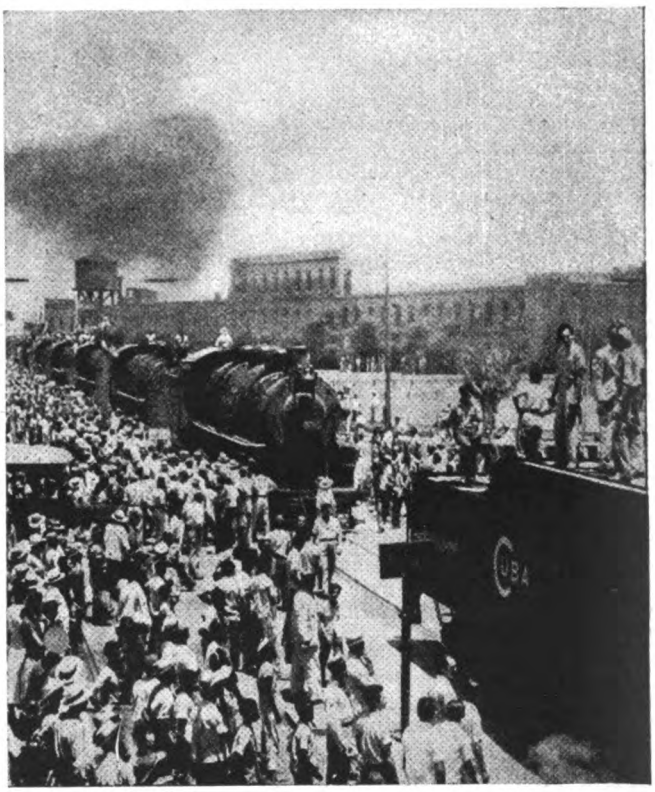
(*Turn to second left-hand page*)



ONE OF TEN ALCO LOCOMOTIVES built for the Consolidated Railroads of Cuba.



DEBARKATION – first of the ten ALCO locomotives is hoisted from ship's hold in Cuba.



AT CAMAGÜEY –two trains of five new ALCO locomotives each arrive at Camagüey headquarters.

WELCOME TO CUBA –the new ALCO locomotives are inducted into the service of railroad and nation by the President of Cuba.

American Locomotive

THE MARK OF MODERN LOCOMOTION

W. E. HUNTER, master mechanic, with headquarters at Covington, Ky., and De-Coursey, has retired after more than 40 years of service.

R. AMUNDSEN has been appointed division master mechanic of the St. Lawrence division of the Canadian National, with headquarters at Turcot, Que.

R. J. DUNN, acting master mechanic of the Union Pacific at Kansas City, Kan., has been appointed district foreman, with headquarters at North Platte, Neb.

S. H. DUBOSE, who temporarily occupied the position of master mechanic at Somerset, Ky., has returned to his post as master mechanic at Ludlow, Ky.

JOSEPH T. CORDER, district foreman of the Union Pacific at North Platte, Neb., has been promoted to the position of general foreman, locomotive department, at North Platte.

K. A. LENTZ, who temporarily occupied the position of master mechanic of the Southern at Birmingham, Ala., has returned to the position of master mechanic he formerly held at Somerset, Ky.

P. C. BRANCH, who temporarily occupied the position of master mechanic of the Southern at Ludlow, Ky., has returned to the position of general foreman he formerly held at Birmingham, Ala.

W. A. SHIELDS, road foreman of engines of the Chicago Terminal division of the Pennsylvania, has been appointed road foreman of engines of the Philadelphia division.

J. L. PARKER, assistant master mechanic of the Lake division of the Pennsylvania, has been appointed master mechanic of the Chicago Terminal division, with headquarters at Chicago.

OTTO STURM, assistant master mechanic of the Delaware, Lackawanna & Western at Scranton, Pa., has been appointed master mechanic, with jurisdiction over the Scranton division, Bloomsburg branch, and Syracuse and Utica branches.

N. M. KERR, master mechanic of the St. Lawrence division of the Canadian National at Turcot, Que., has retired.

R. L. TURNER, master mechanic of the Southern at Asheville, N. C., has been transferred to the position of master mechanic at Atlanta, Ga.

A. R. SYKES, master mechanic of the Southern Kansas-Central divisions of the Missouri Pacific, who has been on leave of absence since last December, has returned to his position and his headquarters at Coffeyville, Kan.

J. N. FOX, superintendent of equipment of the Illinois Central at Chicago, has been appointed master mechanic at Memphis, Tenn.

C. H. SUITS, road foreman of engines of the Union Pacific at North Platte, Neb., has been transferred to the position of road foreman of engines at Cheyenne, Wyo.

A. G. WALDRUPE, shop superintendent of the Southern at Knoxville, Tenn., has been appointed master mechanic at Bristol, Va.

D. J. EVERETT has been appointed acting master mechanic of the Western division of the Atchison, Topeka & Santa Fe, with headquarters at Dodge City, Kan.

J. M. JEFFREY, assistant master mechanic of the Illinois Central at Markham, Ill., has been appointed master mechanic, with headquarters at Centralia, Ill.

F. T. WALDEN has returned to his position as master mechanic of the Southern at Birmingham, Ala., after a leave of absence.

C. T. EAKER, general foreman of the Illinois Central at Memphis, Tenn., has been appointed master mechanic, with headquarters at Paducah, Ky.

H. N. SEELY, master mechanic of the Illinois Central at Centralia, Ill., has retired because of sickness.

R. W. ELLIS, master mechanic of the Illinois Central at Memphis, Tenn., has been transferred to the position of general master mechanic at Waterloo, Iowa.

F. E. KIMBALL, general foreman of the Southern at Asheville, N. C., has been promoted to the position of master mechanic at Asheville.

CHARLES S. WILLIAMS has been appointed general foreman, Diesel locomotive shop of the Delaware, Lackawanna & Western, with headquarters at Scranton, Pa. Mr. Williams will continue the supervision of automatic cab signal equipment and electrical maintenance features of locomotives.

Shop and Enginehouse

E. A. MURRAY, shop superintendent of the Chesapeake & Ohio at Huntington, W. Va., who has retired as announced in the June issue, was born on September 1, 1876, at Staunton, Va. He received a public-

E. A. Murray

school education and on December 11, 1891, entered the employ of the Chesapeake & Ohio as a laborer at Clifton Forge, Va. He later became a machinist apprentice and subsequently served as a machinist, locomotive fireman, and gang foreman until 1903 when he was promoted to the position of general foreman, locomotive department. In 1909 he was appointed master mechanic at Clifton Forge and in 1921 shop superintendent at Huntington. He retired on April 15.

Obituary

THOMAS ROOPE, who retired in 1926 as superintendent of motive power of the Chicago, Burlington & Quincy, Lines West, died at Lincoln, Neb., on June 20.

MATTHEW SCOTT SLOAN, chairman of the board and president of the Missouri-Kansas-Texas Lines and subsidiaries, died of a heart attack on June 14 in New York Hospital, New York. He was 63 years of age. Mr. Sloan began his career with the General Electric Company at Schenectady, N. Y., in 1902. Four years later he became chief engineer of the Birmingham Railway, Light & Power Co., rising to the position

Matthew Scott Sloan

of assistant to the president. He was appointed vice-president and general manager of the New Orleans Railway & Light Co., in 1914 and in 1917 went to New York as assistant to the vice-president and general manager of the New York Edison Company. He was elected president of the Brooklyn Edison Company in 1919 and when the Consolidated Gas Company purchased the Brooklyn firm in 1928, he was elected president of the New York Edison Company and the three other neighboring utility companies. He resigned his Edison positions in 1932 and two years later assumed leadership of the Katy system.

In Military Service

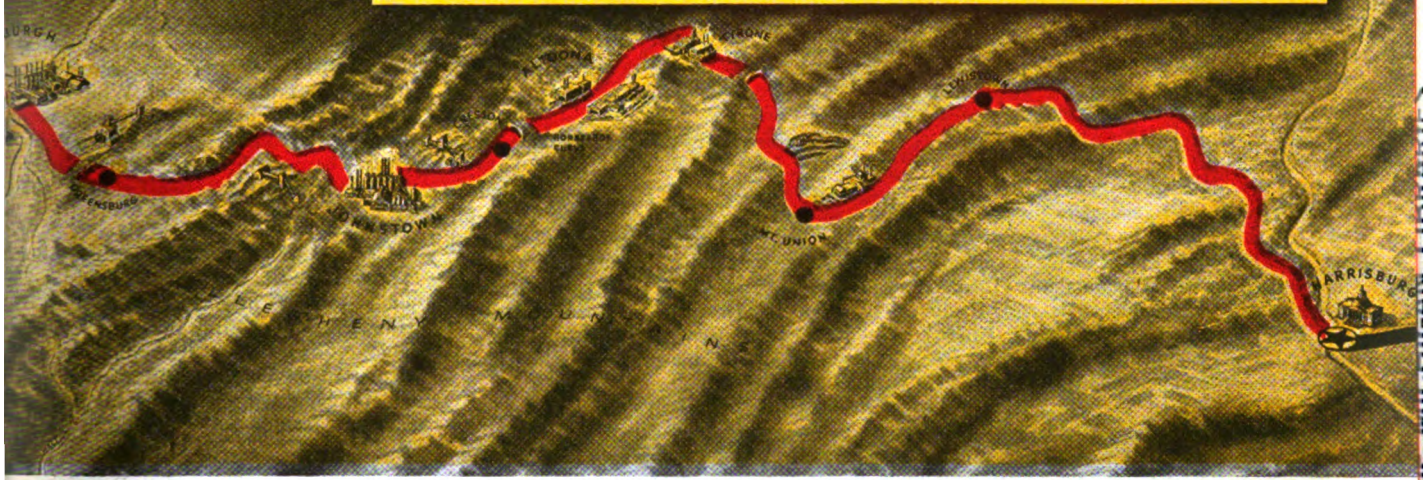
ORDER OF THE BRITISH EMPIRE CONFERRED ON GEN. GRAY

Brig. Gen. Carl R. Gray, Jr., director general of the Military Railway Service, and former executive vice-president of the Chicago, St. Paul, Minneapolis & Omaha, has been made Honorary Commander, Order of the British Empire, Military division. The citation conferring this honor reads as follows:

(Continued on next left-hand page)

For main-line service the Pennsylvania chooses

"UNION" I.T.C.



"UNION" I. T. C. ON THE PENNSYLVANIA

1940: Columbus, Ohio. One-way equipment in hump yard.

1942: Indianapolis, Ind. One-way equipment in hump yard.

Trenton, N.J. to Phillipsburg. Two-way equipment for road service on Belvidere branch.

1943: Altoona, Pa. One-way equipment in two hump yards.

Harrisburg, Pa. (Enola Yards). One-way equipment in two hump yards.

Pitcairn, Pa. One-way equipment in hump yard.

1944: Pittsburgh, Pa. (Strip District). Two-way equipment in an industrial switching district.

1945: Pittsburgh, Pa. to Harrisburg. Under construction.

Train Communication equipment is now under construction on two of the busiest divisions of the Pennsylvania Railroad between Harrisburg and Pittsburgh.

The "Union" Inductive system has been chosen because the Pennsylvania knows *from its own experience* that "Union" I.T.C. meets railroad needs. "Union" I.T.C. was installed in the Columbus, Ohio yard of the Pennsylvania in 1940; today this system is in use in eight of the Pennsylvania's busiest yards.

For nearly three years, "Union" I.T.C. has been in road service between Phillipsburg and Trenton, on the Belvidere branch.

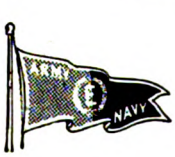
This record of satisfactory performance made "Union" I.T.C. the inevitable choice when the Pennsylvania decided to use Train Communication in main-line service. Two-way equipment will be installed on approximately 275 freight and passenger locomotives, 90 cabin cars and 6 towers. This will serve two four-track divisions totaling 245 road miles.

Recently, train communication and its relation to railroad operation were discussed at the New York Railroad Club. We will be glad to send you a reprint of the proceedings.

UNION SWITCH & SIGNAL COMPANY

SWISSVALE, PA.

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO



"The repair of railroads in Italy and the organization of traffic on them were among the most important governing factors limiting the pace of the Allied advance. Brig. Gen. Carl R. Gray brought to this task first-class ability, wide experience and great driving power. Under his leadership, American and British resources were successfully combined for the fulfillment of the common purpose. The allied armies in Italy owe to General Gray a great debt for the magnificent work which he did while Director General of the Military Railways there."

EQUIPMENT SECTION, GENERAL HEADQUARTERS, MILITARY RAILWAY SERVICE

The uniformed men shown in the group photograph are officers of the original and present equipment section of General Headquarters, Military Railway Service, in the European Theater of Operations. The Headquarters has charge of planning and control of Military Railway Service and general jurisdiction over the entire operation—more than 2,000 steam locomotives, 200 Diesels, 50 hospital trains, and 40,000 freight cars of the U. S. Army, as well as 30,000 men.

Left to right, the officers are: Maj. Horace G. Moore, general car superintendent (formerly with the Atlantic Coast Line at Jacksonville, Fla.); Col. Frank H. Hosack, director of equipment (formerly mechanical superintendent, Missouri Pacific, St. Louis, Mo.); Col. Walter M. English, general superintendent motive power (formerly superintendent motive power, Chicago, Indianapolis & Louisville, Lafayette, Ind.); and Lt. Col. James H. Heron, general mechanical engineer (formerly with the Great Northern at St. Paul, Minn.).

757TH RAILWAY SHOP BATTALION

When Lt. Col. John W. Moe, former C. M. St. P. & P. enginehouse foreman and his Milwaukee-sponsored 757th railway shop battalion moved into Germany after 10 months at Cherbourg, they were confronted by the "huge task" of taking over the damaged Henshall & Sohn locomotive works, which Headquarters reports to be "about equal in size" to the Baldwin plant at Philadelphia.

The German plant was a "debris-strewn mass of twisted girders, crumpled machinery and shattered locomotives and cars," when the 757th moved in. But the job of hastening the project goes on, and with most of the 4,000 employees who worked there before U. S. occupation, Headquarters recently reported. While some of the lathes and machinery are said to be intact, there is evidence of hastily abandoned work, the report states, and "all along the assembly line are locomotive frameworks, gun mounts and cannon undergoing the boring process."

Executive officer of this outfit is Capt. Charles E. Smith, of Devon, Pa., former foreman of the Philadelphia Terminal Division of the Pennsylvania, at Philadelphia, Pa.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

"THE SAXE WELDED ERECTION SYSTEM."—J. H. Williams & Co., 400 Vulcan street, Buffalo, N. Y. Four-page bulletin No. 4 shows how the Saxe system works and discusses its advantages.

◆

SHOP EQUIPMENT.—The Watson-Stillman Co., Roselle, N. J. *Bulletin No. 510-A* illustrates and describes W-S line of hydropneumatic pit jacks, including drop-pit tables, in types of the hand-pump-operated telescope, air-engine driven, and drop-pit table models, also special types. *Bulletin No. 560-A* describes such miscellaneous hydraulic equipment for railroad shops as crank-pin and forcing presses, pulling jacks, and rail benders.

RECTIFIERS.—Fansteel Metallurgical Corporation, North Chicago, Ill. "Selenium Rectifiers," a 14-page engineering manual, No. RDP-107, including standard element specifications for selenium rectifiers and rectifier plates.

◆

"SETTING UP A VICTOR WELDING OR CUTTING UNIT."—Victor Equipment Company, 844-54 Folsom street, San Francisco, Calif. 46-page illustrated bulletin for vocational training schools and beginners. Describes in simple, understandable language how to assemble a welding or cutting outfit.

DIESEL-ELECTRIC MAINTENANCE EQUIPMENT.—Whiting Corporation, Harvey, Ill. Sixteen-page illustrated book, "Increased Availability for Your Diesel-Electric Power," outlines the range of Whiting equipment for large or small terminals, for the entirely new shop, and for changed-over shops where facilities are being adapted to the requirements of Diesel-electric power.

◆

CARE AND MAINTENANCE OF BOILER TUBING.—Steel and Tubes Division, Republic Steel Corporation, 224 East One Hundred Thirty-First Street, Cleveland 8, Ohio. Card, for wall nailing, gives information on the care and maintenance of boiler tubing as prepared by the chief engineer of a leading boiler insurance company.

◆

ARC WELDING TOOL AND DIE STEELS.—C. E. Phillips & Company, 2750 Poplar street, Detroit 8, Mich. "Arc Welding in the Maintenance and Construction of Tools and Dies"—a handbook of engineering data, welding procedures and heat-treatment procedures for tool and die steels.

◆

TUBE CLEANERS.—Elliott Company, Jeannette, Pa. Four-page, illustrated Bulletin Y-20. Describes the Lagonda type tube cleaners and summarizes the various types of Elliott cleaner motors and cutter heads developed for special locomotive tubes and pipes.

◆

HIGH-STRENGTH STEELS.—Republic Steel Corporation, Advertising Division, 3100 East Forty-Fifth street, Cleveland 4, Ohio. Four-page folder, Form 434, gives general characteristics, chemical composition, and physical properties of Republic Aldecor, Republic Cor-Ten, and Republic Double-Strength Steels.

◆

"SPEED SURFACE-GRINDING SET-UPS."—George Scherr Company, 200 Lafayette Street, New York 12. Eight-page folder illustrates actual applications of Magne-Blox products employed to hold various types of work for surface-grinding operations. Features also a new service; namely, the production of special sizes of Magne-Blox parallels, v-blocks and angle irons, as well as other shapes and forms to fit any type of magnetic chuck.

Transportation Library

Railway Mechanical Engineer

September 1945

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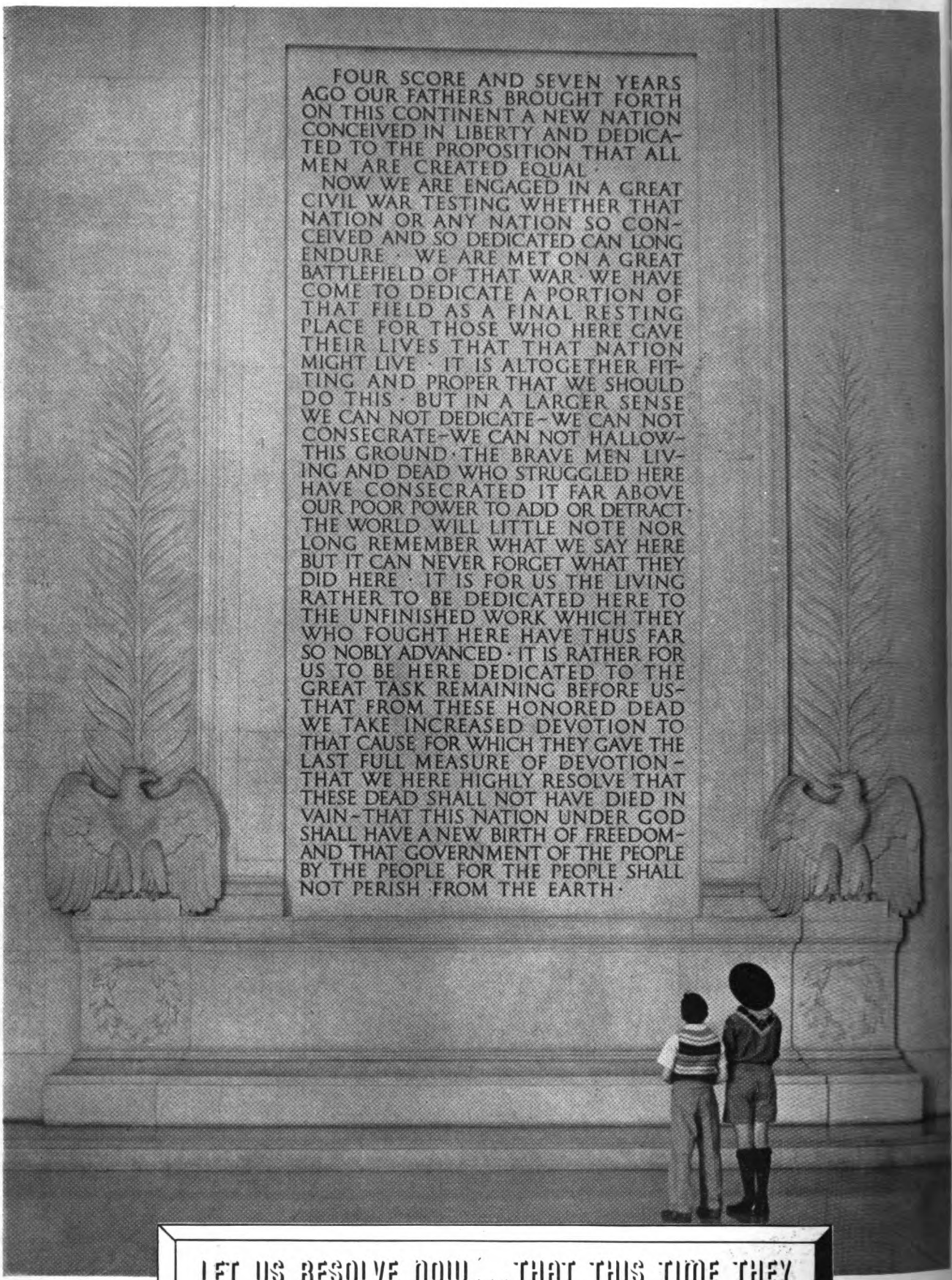

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SEPTEMBER, 1945

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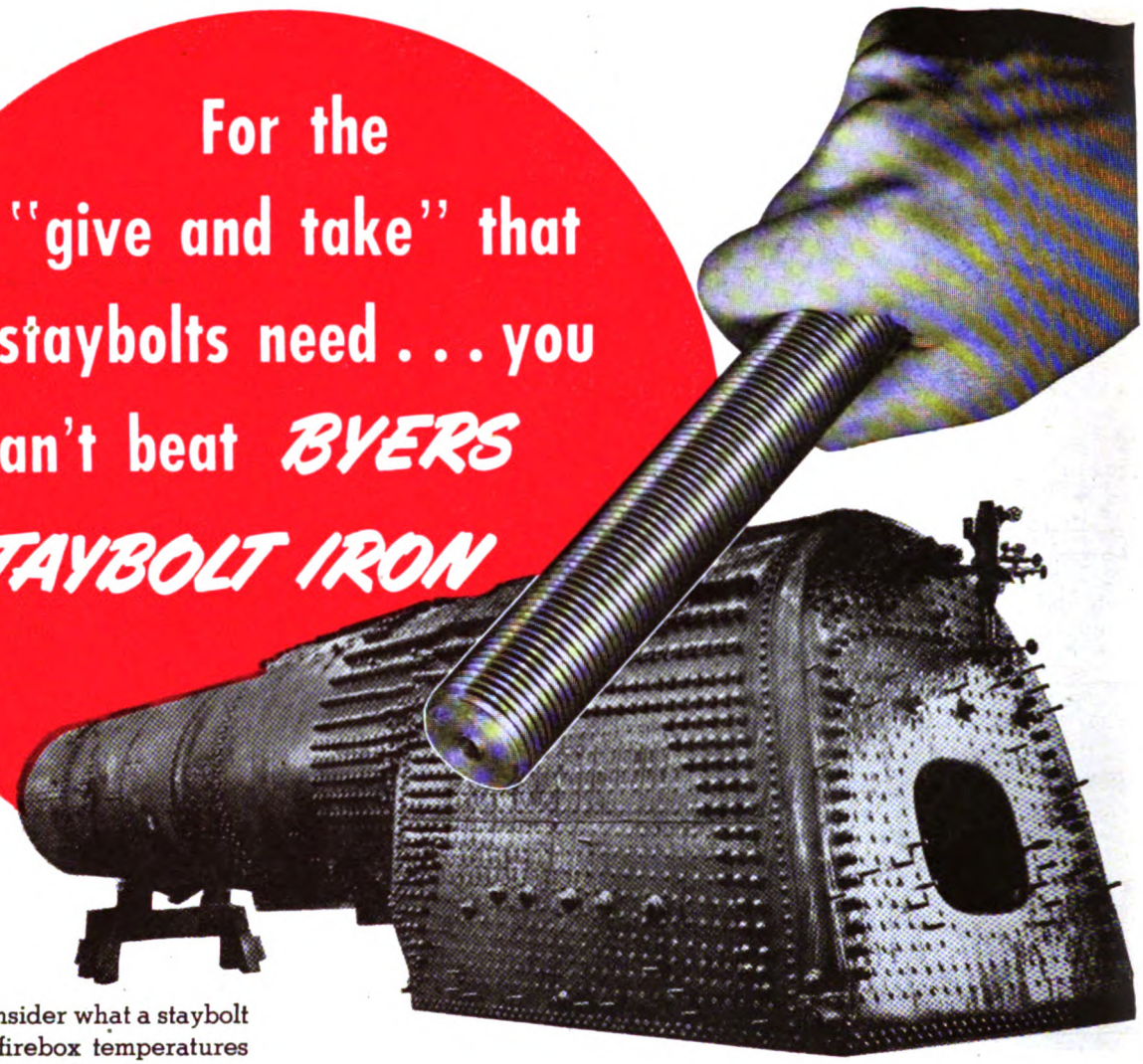
For the "give and take" that staybolts need . . . you can't beat BYERS STAYBOLT IRON



When you consider what a staybolt has to take—firebox temperatures up to 2700°; cinder abrasion; water and steam temperatures up to 450°; continuous vibration and shock; and corrosive attack, while under a stress of 3000-lbs. or more—it emphasizes the importance of the unusual combination of qualities that Byers Staybolt Iron has to give.

Byers Staybolt Iron is ductile and malleable. It is readily headed, and working does not change its physical properties. It is true to size and round, giving full, sharp clean threads with maximum holding power. It is uniform in analysis, and free from hard spots, which cuts machining and drilling rejects. It is not vulnerable to vibration, has a high degree of corrosion resistance, and withstands firebox punishment.

FORGING BILLETS. The same unusually high quality and uniformity found in Byers Staybolt Iron is duplicated in Byers Forging Billets. They are produced in round, square or rectangular sections, under ASTM-A-73 and AAR-M-307 Specifications.

The reason for these essential service qualities is found in the unusual nature of Byers Staybolt Iron, and in its exclusive method of manufacture. The tiny fibers of glass-like silicate slag that are threaded through the body of high-purity iron give a structure similar to that of a stranded wire cable. This combats fatigue failure, and the fibers halt and deflect corrosive attack. The tremendous rolling reductions used in manufacturing Byers Staybolt Iron help give the best possible slag distribution . . . a highly important requirement in assuring maximum durability.

Over seventy-five railroads have equipped locomotives with Byers Staybolt Iron to stand the increased responsibilities of wartime traffic. You can specify Byers Staybolt Iron in ordering from your staybolt manufacturer, or obtain blanks for machining in your own shop. The delivery situation is very satisfactory at present.

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TUBULAR AND HOT ROLLED PRODUCTS
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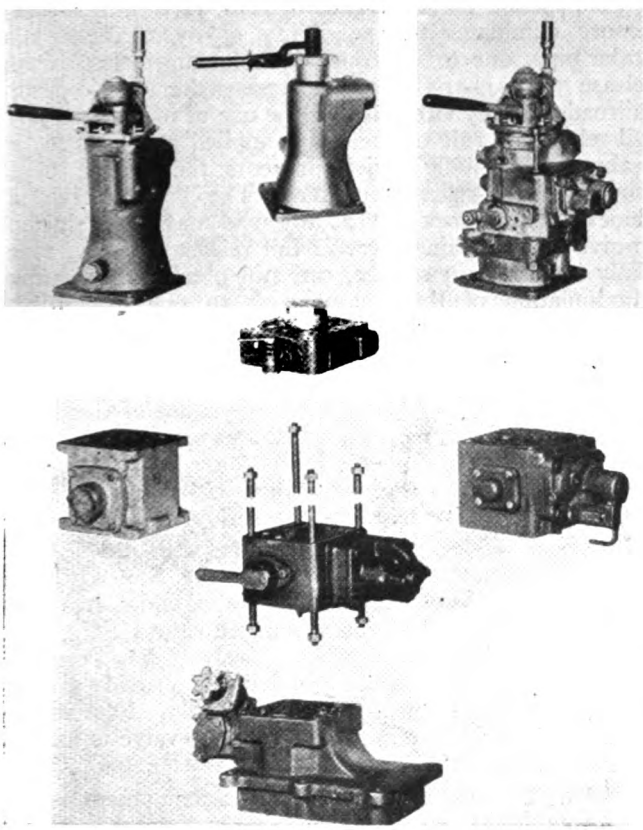
Developments in Car and Locomotive

Brakes and Control Equipment*

By A. S. Benton†

Progress made during war in engineering improvements for new and old railway equipment—Required changes made to meet lightweight and high speeds

We are at the threshold of a new era in transportation, particularly in railroad transportation. The railroads and the equipment builders have not been idle during the war period even though their facilities were, in most cases, devoted for long periods exclusively to standardized production for war transportation. New and more easily controlled Diesel locomotives have been introduced. Improved steam locomotives of greater power and efficiency have been built and placed in operation. A number of new freight car designs have been produced, in small quantities to be sure, so far, but offering the advantages of lighter weight, less maintenance, and greater suitability for high-speed service. Passenger cars likewise have been undergoing equal development, pointing toward greater convenience, comfort, speed and attractiveness from the passenger's viewpoint, although their actual production was halted.



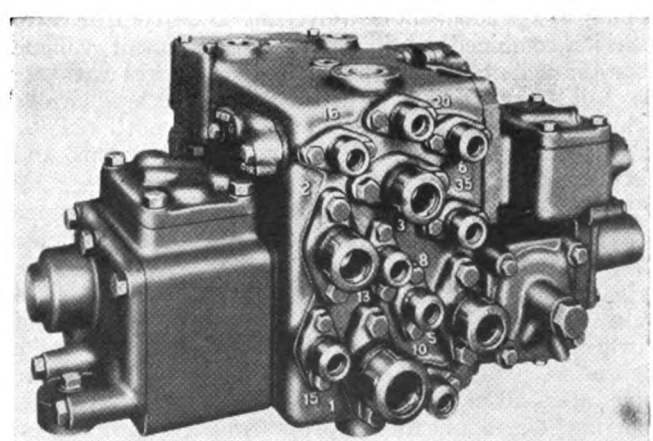
Top to bottom: Left—Brake valve portion and application portion (emergency); Center—Brake valve portion (rigid handle; rotary valve and seat (same for all); filling piece portion (same for all); pipe bracket portion: Right—Brake valve portion (for pneumatic straight air); application portion (service)

The D-24 brake valve portions

With this advancement in equipment, the matter of control becomes more and more important, particularly as train speed increases. The air brake is a relatively small item, but is very important in this control. The designer of air brake equipment must be constantly adjusting his thinking to match the trend in the development of railroad transportation. Equipment changes are not offered just to be new, but are developed to properly meet new problems presented because of changed operating conditions, new demands made on the equipment, etc. A typical example of this is the need which caused us to develop and just recently introduce the No. 24-RL locomotive brake equipment.

Locomotive Controls

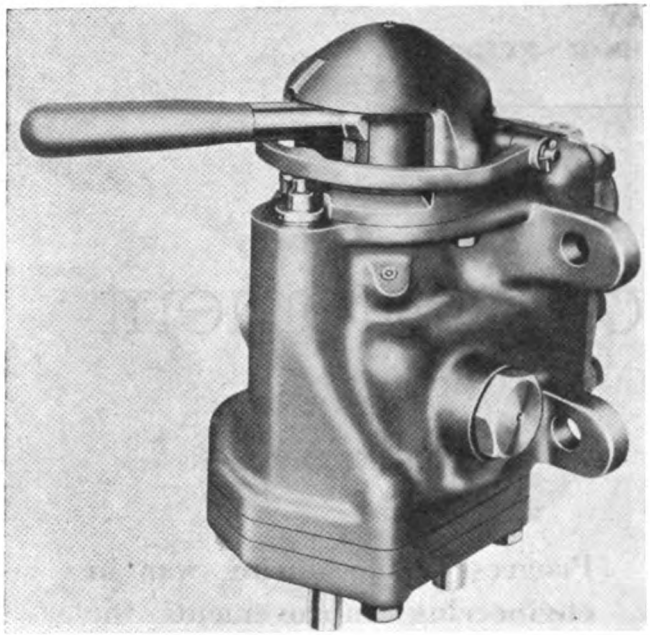
Earlier locomotive brake equipment rather naturally developed into two types to meet two general classes of service. The two types of equipment and the two classes of service are the No. 8-ET locomotive brake equipment



Back of the D-24 control valve

* A paper delivered before the Southern and Southwestern Railway Club at Atlanta, Ga., on May 17, 1945.

† District representative, Westinghouse Air Brake Co., Atlanta, Ga.



D-1 controller

which was particularly developed for conventional speed passenger trains and long heavy freight trains, and the HSC equipment especially designed to include such features as electropneumatic control, speed governor control, etc., associated with the relatively new high-speed passenger service employing streamlined cars.

These locomotive brake equipments were developed at two different time intervals and for rather specific purposes. While they are quite satisfactory for their particular fields they do not lend themselves conveniently to being converted from one type of service to the other. In addition, they, of course, involve maintenance of two distinct types of equipment. As a result there developed an insistent demand that a single type of locomotive brake equipment be offered which would provide the basic requirement for heavy freight and conventional passenger service, and at the same time readily permit incorporation of all additional features required for the high-speed train service. The incorporation of the additional features desired had to be accomplished without discarding any of the basic features or change in the basic piping, by merely adding the required functional apparatus. This has been accomplished, and as a result we have the No. 24-RL type of locomotive brake equipment. The new items of major importance in this equipment are the D-24 brake valve including the S-40-D self-lapping independent brake valve, the D-24 control valve with its combined auxiliary and displacement volume reservoir and the relay valve. This compares with the No. 8-ET equipment which has the No. 8 brake valve including the automatic and independent portions, the No. 8 distributing valve with its reservoir portions, and the brake-pipe vent valve.

The brake valves shown in one of the illustrations are intended for Diesel locomotive service. The D-24 brake valve for steam locomotives is similar, except for the style of handle and the top portion employed. The D-24 brake valve is the simplest or basic form that would provide safety control features with emergency brake application for Diesel engine use. The DS-24 brake valve offers all of the features of the basic valve, and by changing the application portion only it provides a service type of brake application for safety control, overspeed control, or train control application. The DSA-24 brake valve incorporates the features of the others, and by changing only the body portion, the straight-air feature required for electro-pneumatic control is provided. Many of the parts of these three brake valves are common to all and, therefore, the problem of maintenance, testing, etc., is greatly simplified.

Improved Feed Valve

In designing the D-24 brake valve a special effort was made to include any new features or improvements that seemed desirable. As a result, we have the new D-24 feed valve. This feed valve has materially increased the flow capacity and is also much more sensitive to air demands, so that it will regulate pressure within a considerably narrower range than any previous feed valves. Its design is such that the maintenance required should be less and should also be more easily accomplished than with previous feed valves. The greatly increased capacity of the D-24 feed valve enables us to offer for the first time, a controlled-pressure full-release position in the brake valve. This greatly increased feed-valve flow capacity makes possible the charging of long trains as rapidly as when using the main reservoir pressure full-release type of brake valve.

The use of the controlled-or-feed valve full release feature eliminates the possibility of overcharging the brake pipe, due to improper use of main-reservoir full release when charging or recharging the train. Many railroads already either forbid the use of main-reservoir-full-release by rule or they have applied nullifiers to the brake valve handle which prevents the handle being moved to full-release position. The brake valve includes a cutout cock so that any who may feel reluctant to give up the main reservoir full release entirely, especially in mountain service, can still obtain that feature. Manipulation of this cutout cock to one of its two positions, provides the controlled pressure in the full release position, whereas the other position of the cutout cock substitutes main-reservoir pressure for the controlled pressure in the full release position of the brake valve. With the brake valve in running position, the feed valve delivery to the brake pipe is choked to provide the same capacity as it obtained with the No. 8 brake valve and M-3 feed valve in running position.

The independent brake operation with the 24-RL equipment is accomplished through the S-40-D brake valve. This is a self-lapping type valve which has been in service previously in connection with the HSC equipment as an independent brake valve. It has been designed for separate mounting in order to provide greater flexibility of location in the Diesel cab. For steam-locomotive service the independent brake valve is located on the automatic brake-valve body.

The next major item of the 24-RL equipment is the D-24 control valve. A control valve was selected, rather than a distributing valve, as it is desirable to separate the application or relay portion from the remainder of the valve for convenience in adding the electro-pneumatic and speed governor features. The control valve also incorporates an emergency portion which makes it unnecessary to employ a brake-pipe vent valve.

The D-24 control valve is arranged much like the D-22 type control valve, in that it has a pipe bracket, a service and an emergency portion. It is smaller and lighter and somewhat simplified as compared with the D-22-E control valve. It is also smaller and lighter than the distributing valve and provides advantages over the distributing valve in that a faster and more positive release of the rear unit of the locomotive is obtained when operating in multiple unit service. It provides

better graduation than is possible with the distributing valve. The brake cylinder pressure developed with the control valve is also exactly in harmony with the similar pressure development on the cars. The emergency portion of the control valve is similar to that used on the AB valve, thus facilitating maintenance. The D-24 control valve also provides automatic sanding in emergency.

The use of the control valve makes necessary the combined auxiliary, emergency and displacement volume reservoir for control of the relay portion. This reservoir is similar to that furnished in connection with previous locomotive control valve equipment.

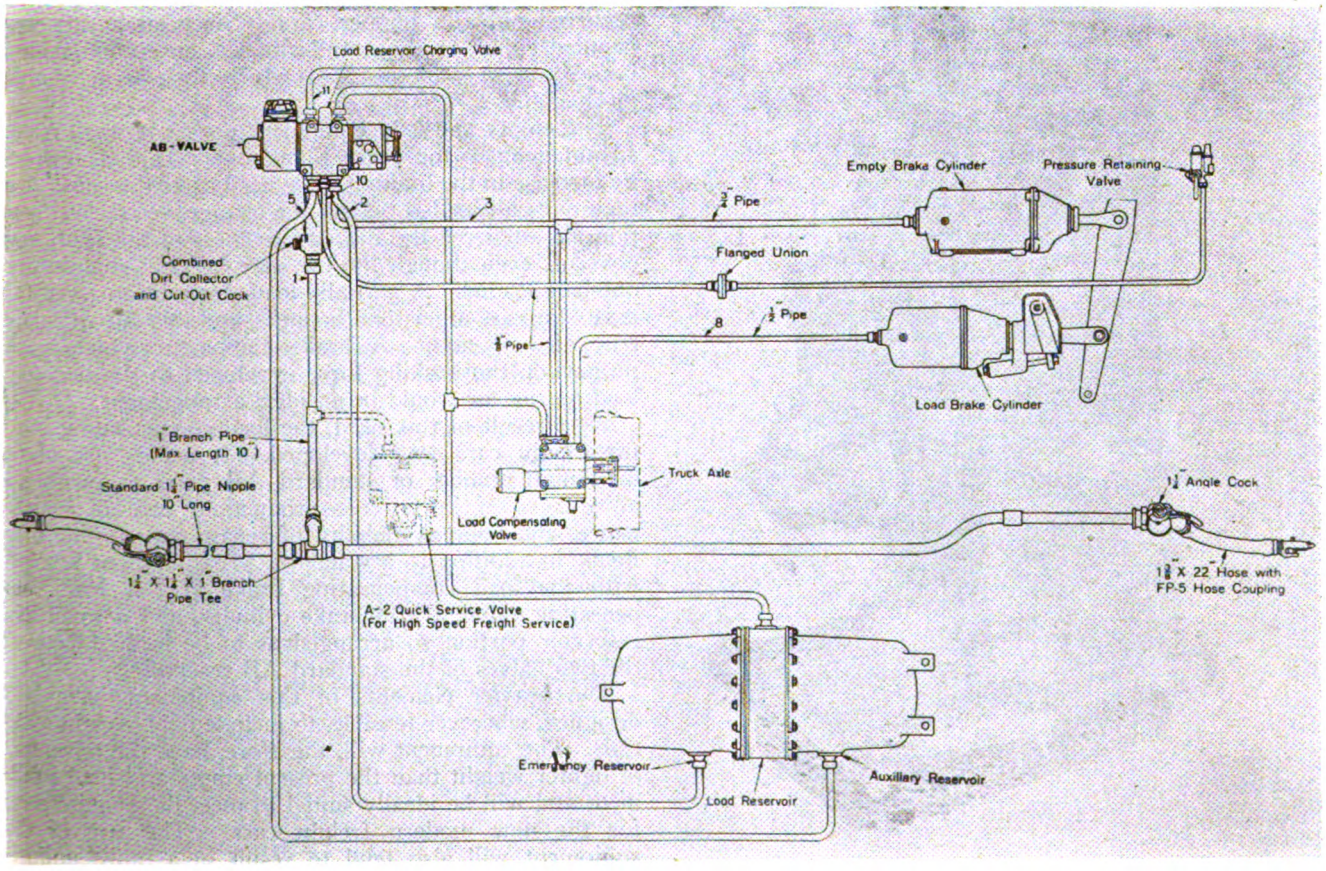
It is desirable to have the application or relay portion as a separate unit because it lends itself better to the addition of the electro-pneumatic, decelostat and speed governor features. Where speed governor control is employed, or contemplated for later use, the F type relay is recommended. This relay has provision for mounting the magnet valves required for speed governor operation and also includes a relay portion which is generally similar to the application portion of the distributing valve. If the electric features are not required, the familiar type B relay valve is used in place of the F type valve. These are the major new items of the 24-RL locomotive brake control.

Pneumatic Throttle Control

There is, however, a new development in pneumatic control for the locomotive which concerns throttle operation. For Diesel engine service, the self-lapping principle of the independent brake valve has been utilized to provide control for the engine speed. This portion of the equipment is called a Controlair. The Controlair is connected pneumatically through a single line of tubing to another device, called the actuator. Movement of the Controlair handle the desired amount causes the actuator to position the engine governor so as to obtain the change in speed desired.

More complete types of the Controlair equipment provide for reverser control in the same handle as is used to control the engine speed. Thus moving the Controlair handle forward from the neutral or idle position insures proper positioning of the reverser and also the increase of engine speed as desired. Movement of the handle in reverse from the neutral or idle position again positions the reverser for the proper electrical connections and then permits increase of the engine speed to the desired degree. These features are all suitably interlocked to preclude the possibility of their being improperly used. Either of the two Controlair systems will permit the control of more than one engine from a single Controlair by employing additional actuators and the necessary piping.

A similar throttle control has also been developed and applied to one of the newest and most powerful steam engines in operation today. On account of the different characteristics of the force required to operate the steam throttle and because of the considerable travel of the throttle arm of a steam throttle, a device known as a pneudyne is employed, in place of the actuator referred to above. The reversing of the locomotive in this case is also taken care of with the same Controlair handle as is used for the steam throttle operation. Suitable interlocks are, of course, provided. The advantages of the pneumatic system of control are obvious, in that it requires only a nominal amount of force on the part of the engineman to adjust the throttle to the desired position.



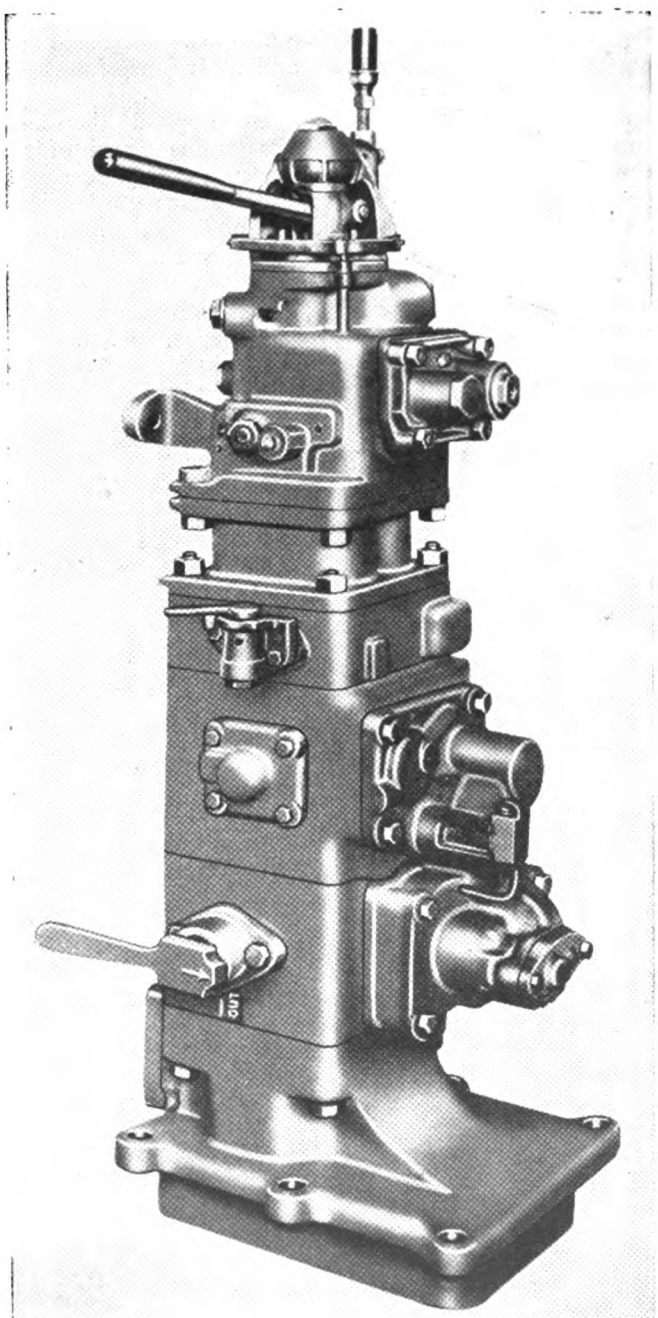
Piping diagram of the load compensating brake

It is also much easier to accomplish the installation of the tubing connecting the Controlair and actuator or pneudyne, than it is to install the mechanical system of levers, bell cranks, etc., otherwise employed.

Air Compressor

Another recent development for steam locomotives is the 8½ inch—150-E compressor. It incorporates the super-type steam governor directly in the compressor top head. This simplifies the steam piping and makes for more compact assembly. The main new feature is the mechanical lubricator. It is mounted directly on the high pressure cylinder, which method of mounting eliminates the need of all external piping, with the exception of the single line leading to the steam end of the compressor. The pumping units, of which there are three, are individually adjustable to give just the right quantity of oil feed desired to the points requiring lubrication. Oil is supplied to the steam end in the steam inlet passage, just before it reaches the governor, so that all parts of the steam portion are lubricated from this one source. Oil is also supplied to each of the high and low pressure air cylinders. The pumping units are cam driven, which insures their dependable and positive action. The oil passages of the high- and low-pressure air cylinders are drilled in the cylinder side wall, so that there are no external connections involved for this purpose. Having the compressor design such that it is complete with lubricator and governor all in a single unit is a distinct advantage in servicing the compressor.

All 8½ inch-150 and 8½ inch-120 air cylinders, whether furnished as repair cylinders or assembled in complete compressors, supplied since approximately January 1, 1944, have had the necessary bosses for mounting this lubricator. Suitable blanking covers are used to cover these bosses, when the lubricator is not employed.



DSA-24 brake valve

Freight Car Braking

The AB equipment, of course, remains the fundamental standard for freight cars in conventional service where the ratio between empty and loaded weight does not exceed 4 to 1 gross to tare. Many new cars, however, will be designed especially to provide lighter empty weight. Their carrying capacity can be the axle load limit of 169,000 lb. so far as the 50-ton car design is concerned. Many of these light-weight, high-capacity cars will exceed the 4-to-1 gross-to-tare-limitation, and for that reason some additional braking force should be provided. The additional braking force is needed to increase the ability to stop the car to the minimum value that experience has shown as necessary to properly control the movement of trains, especially if grades are involved. Any increase in train speed makes a train more difficult to stop, and correspondingly the need for adequate braking force is even more important. In the past this situation with respect to gross to tare, has generally occurred only on hopper cars. Since such cars were handled either empty or fully loaded, an empty-and-load brake system was provided which took care of them nicely.

The empty-and-load equipment does not work out so advantageously for other than hopper cars as there is no increase in the braking force until after the car is more than one-half loaded. After the changeover to load position has occurred the full effectiveness of the load brake governs, even though the car may be only slightly over one-half loaded. A partially-loaded condition frequently exists for cars other than hoppers, and this is particularly true of box cars. A brake equipment which would proportion the braking force developed to the degree of load on the car would be an ideal arrangement.

As a result of this need, the load compensating brake for freight cars was developed. It makes use of the maximum number of standard AB parts to insure the advantages of lower cost production, ease of maintenance, and wide availability of repair parts. The main items, in addition to a standard AB equipment involved with the load compensating brake are: a load compensating valve, a load brake cylinder, and a small load reservoir portion so arranged as to be located between the two halves of the standard AB reservoir.

The heavier elements of this equipment have been designed, wherever feasible, to include light-weight materials. The equipment will, therefore, have the advantage of lighter weight than the present empty-and-load equipment and will be ideally suited to meet the requirements for the new modern freight cars. The use of this equipment will also tend to result in a more uniform braking ratio throughout the train. This is particularly

desirable from the standpoint of slack control, as there will be much less variation in the retardation force developed on the various cars in the train, irrespective of whether they are empty, partially-loaded, or fully-loaded.

Braking Ratios

The table indicates the variation in braking ratio that will exist between light and loaded cars, having lightweight construction, and with and without the load compensating feature.

The table shows that any car which has a light weight of less than 40,500 lb., when braked at 75 per cent of the empty weight, will have a loaded braking ratio of less than the desired 18 per cent, unless additional braking force, such as the load compensating brake provides, is made available. A 38,000 lb. car has been mentioned frequently as immediately in prospect, and indicates on the chart the values applying for such a weight of car both with and without load compensation. It is to be noted that the lighter the empty weight of the car, the more important this compensating feature becomes to the successful employment of light-weight construction.

Comparative Braking Ratios With and Without Load Compensating Brake for Various Empty Car Weights

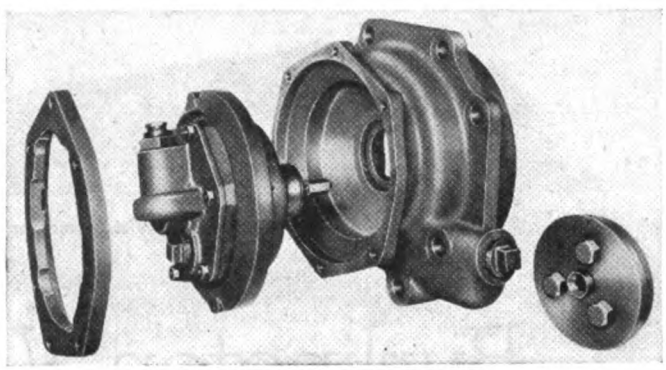
Empty wt., lb.	Axle load limit, lb.	Gross to tare	Empty car braking ratio, per cent	Single-cap. loading car braking ratio per cent 10-in. equip.	Optional percentage of loaded car braking ratio, with load compensating brake
50,000	169,000	3.38:1	75	22.8	50
40,500	169,000	4.0:1	75	18.0	45
38,000	169,000	4.45:1	75	16.85	42
30,000	169,000	5.92:1	75	13.3	33
28,000	169,000	6.04:1	75	12.4	31

Another recent development in freight brakes is the AB-1-B equipment. This was designed to meet the requirements of freight cars occasionally assigned to passenger service or regularly operating in relatively short high-speed freight trains where the freight cars are provided with air signal lines. This equipment is the basic AB equipment to which a filling piece is added between the AB valve service portion and pipe bracket. This filling piece is actuated by the signal line pressure. When the signal line is charged, the three-stage brake cylinder pressure development necessary for slack control on long freight trains is modified to make the brake cylinder pressure development continuous, so that it will harmonize with the practice on standard passenger cars. This filling piece feature includes the protection of a safety valve for service applications, when operated in passenger trains. The safety valve is automatically cut out in such emergency applications. When the signal line is not charged, the AB-1-B valve automatically reverts to provide the standard AB features for freight car service. This equipment is not intended for use on passenger cars.

Passenger Brake Improvements

Passenger cars intended only for conventional speed service should be equipped with the D-22-AR control valve, with which you are quite familiar. If high-speed streamline passenger car operation is involved, higher braking ratios of 250 per cent based on 100-lb. cylinder pressure in emergency are necessary in order to keep stopping distances within proper limits. Such a high braking ratio cannot be permitted at the lower car speeds or excessive wheel sliding will be encountered. It is necessary, therefore, to reduce the braking ratio to values known by experience to give the highest possible retardation without wheel slipping under normally good rail conditions. The HSC equipment with the D-22-BR control valve and the electric speed governor should be employed for this class of car. The speed governor serves to reduce the braking ratio in the desired steps from the maximum of 250 per cent with 100 lb. cylinder pressure in emergency for speeds above 65 m.p.h. to values of 200 per cent, 150 per cent, and a minimum of 100 per cent as the speed decreases.

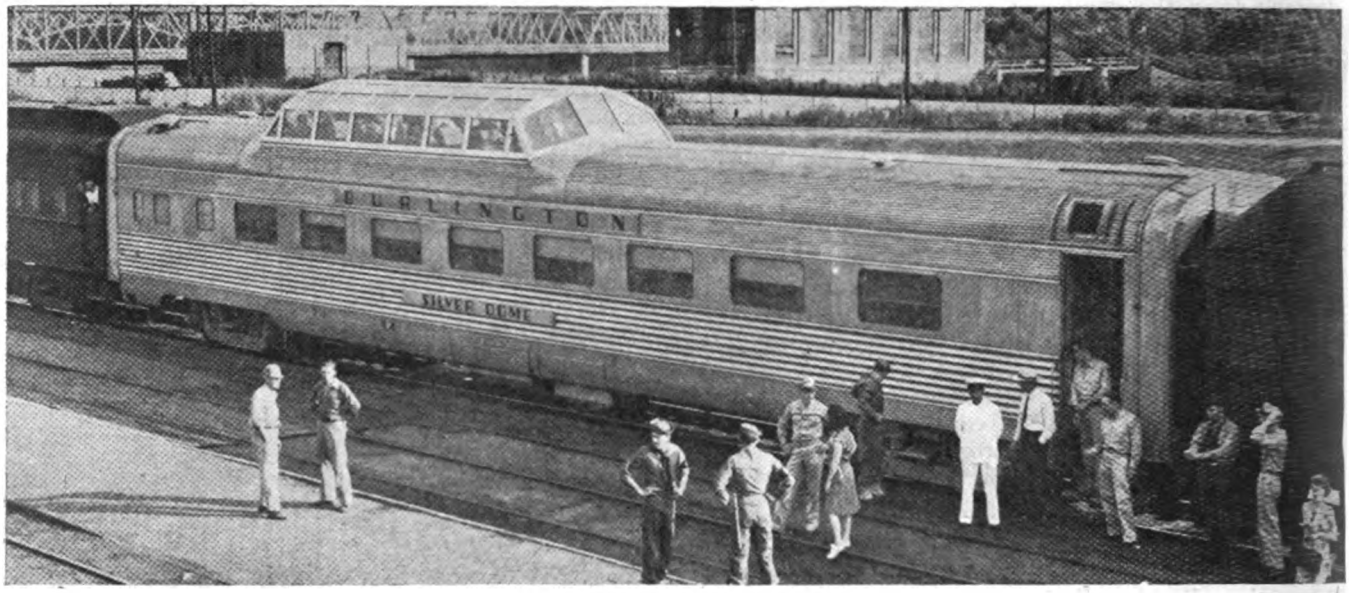
To obtain the maximum in flexibility of control, smooth handling and the greatest saving in time when making fast schedules, the electric straight air feature is recommended. This requires the No. 21-B magnet valve on each car. The electric feature eliminates the element of pneumatic transmission time, thus requiring less time in making stops or slow downs and in releasing after such applications. It also eliminates the probability of any slack action due to brake application, as all brakes in the train apply simultaneously.



AP Decelostat disassembled

While the foregoing features go as far as possible, without the addition of special equipment, to minimize the possibility of wheel sliding, they must be based on normally good rail adhesion or the stops will be unnecessarily long. To eliminate wheel sliding under adverse rail conditions, the type AP decelostat equipment was developed. This equipment involves, for one car set, four P-1 decelostats, two B-2 decelostat valves, and four pieces of small diameter flexible hose.

One of the P-1 decelostats is mounted on the end of each axle. There are no electrical connections or attachments required with this equipment and there are no additional connections required to the car body. The decelostat is a small but rugged pneumatic valve combined with a weight mechanism which measures the change in the rate of the wheel retardation. If the wheel retardation stays below a predetermined value, which experience has shown will not approach wheel sliding, the pneumatic mechanism is not required to function. In other words, brake cylinder applications and release occur in an entirely normal manner as though the decelostat equipment was not applied. The decelostat is constantly measuring the retardation rate of the wheel, however, and if the wheel does slip so as to exceed the rate for which the decelostat is adjusted, the decelostat operates to open the B-2 decelostat valve. This almost instantly operates to decrease brake cylinder pressure and thus soften the intensity of the brake application. All of this happens much more quickly than is possible for the wheel to actually stop rotating. The wheel, therefore, almost inmmediately resumes its rotation corresponding to the car speed and the brake cylinder pressure is promptly restored at a predetermined rate. If only one of the decelostats functions, the brake cylinder pressure on that truck only is modified as just described.



Vista-dome car at Ottumwa, Iowa

Burlington Vista-Dome Car

Stainless-steel car with glass-enclosed observation dome in the roof

FURTHER service tests developed "unanimous enthusiasm" for the Vista-Dome stainless chair car of the Chicago, Burlington & Quincy which has been rebuilt to include a steel and glass-enclosed observation compartment extending upward through the roof and made over 7,600 miles in the first two weeks of revenue service since the formal test run on July 23. The objective of the Burlington in making this practical demonstration of the dome-type construction, originally suggested by General Motors "Astra-Liner" designs, was to see if it is sufficiently popular and practicable to justify more extensive adaptation and use. The answer to the first question is already in the affirmative.

The Vista-Dome car, constructed at the Aurora, Ill., shop of the C. B. & Q., was by no means an easy car to build primarily because it necessitated fitting the glass-enclosed observation dome into an existing car and using only such materials as were readily available without drawing on critical war materials. Whereas the General Motors designs called for a depressed center section, the Burlington car was rebuilt without change in the underframe and main floor, seats in both the dome compartment and the main body of the car under the dome being arranged so as to take advantage of the decreased headroom required when sitting as compared with standing.

The Vista-Dome car, in this particular instance designated the Silver Dome, was made from a 79-ft. 8-in. streamlined stainless steel chair car, built in 1940 by the Edward G. Budd Manufacturing Company, Philadelphia, Pa. It provided 52 seats for passengers, not including seats in the women's lounge and the men's smoking room and, as redesigned, the seating capacity is 58. The height of the original car from rail top to roof was 13 ft. 6 in.; the height with the dome added is 16 ft. 2 in., which includes ½-in. camber built into the car body. Some older passenger cars are as high as 14 ft. 8 in. and the Burlington operates freight cars in special service which extend 17 ft. 3 in. above the rail top. The Vista-Dome car can be operated practically anywhere on the Burlington system without exceeding clearance limitations.

The glass-enclosed dome compartment is approximately 22 ft. 6 in. long by 10 ft. wide and contains 24 de luxe seats. The dome extends 2 ft. 8 in. above the former roof, which places passengers' heads and shoulders well above the roof line, giving them a good view in every direction, including forward and back over the top of the train. (Seats are reversible to suit the direction of movement of the car.) The distance from floor to ceiling of the dome compartment is 6 ft. 2 in. The car weighs 130,000 lb. compared with 110,000 lb. before the dome was added and compared with 165,000 lb. for a conventional car. Had the Vista-Dome Dome car been built new, it would not have been much heavier than the original stainless steel chair car.

Trucks used under the rebuilt car are the original trucks, equipped with Timken roller bearings and having lateral and vertical snubbers applied, also stabilizers to resist car sway. While the car was notably easy riding in early tests, it is expected that other improved trucks will be tried under this car in an effort to determine which design functions most effectively in cushioning road shocks.

Owing to the unavailability of curved glass or suitable transparent plastics in war-time, the windows and roof of the dome are constructed of double-pane flat glass. The outer pane is a heat and sunray resisting glass, separated by an air-space from the inner pane which is safety glass. The air-space serves as an insulation against heat

and cold and the provision of dry air between the panes prevents fogging or frosting, which would impair the view from the dome.

The dome section, as well as the balance of the car, is scientifically air-conditioned to insure comfortable temperature and ample ventilation in summer or winter. Illumination is so arranged that, at night, all lights in the dome except those illuminating the floor can be extinguished. This permits passengers to see the right-of-way ahead illuminated by the locomotive's headlight and, on many nights, the entire countryside bathed in moonlight.

For the present at least, the Burlington contemplates that no extra fare will be charged for riding in the dome, although passenger traffic officers anticipate that the popularity of this scenic vantage point may create a problem.

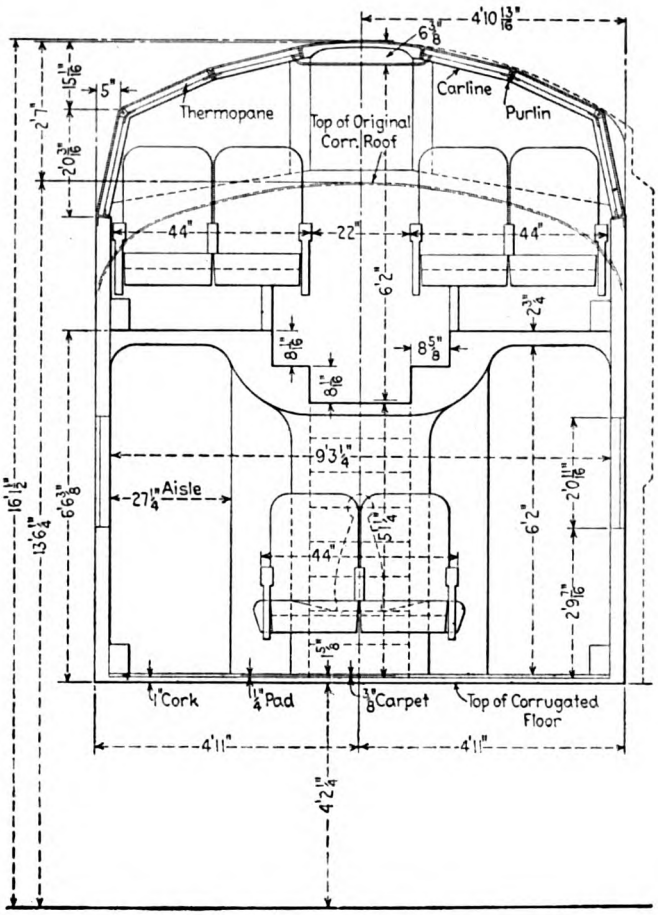
Coincident with the installation of the dome compartment, the main floor of the car has been remodeled and refinished. The main passenger compartment contains 18 reclining chair seats in conventional arrangement. Beneath the dome space, there are 16 seats, 4 of which may be used to form a card-playing section and 12 being placed back-to-back and facing outward toward the windows. The latter are separated by a glass partition. A short stairway, so designed that passengers instinctively grasp double handrails, leads up to the dome compartment. A large women's lounge and a spacious men's room are located at opposite ends of the car.

How the Dome-Car Was Made

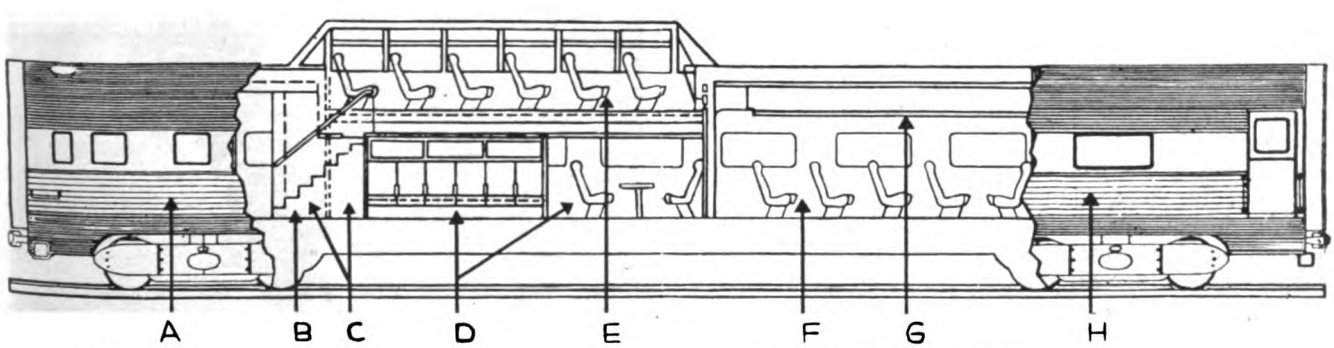
In rebuilding and reconditioning this car at the Aurora shops, both design and construction details were dictated in many instances by the fact that the car was not a new design. For example, the limited headroom available with a straight rather than a depressed center construction, placed definite limitations on how space under the dome compartment could be used. In view of the urgent need for employing only such materials as were, for the most part, already on hand at Aurora shops, many substitute materials and, by the same token, fabricating methods, were utilized. Stainless steel sheets and pressings, joined by the Budd Shotweld process, were used when available in the desired thicknesses, but it was necessary to use arc-welded carbon steel structural shapes for the dome frame, for example, and aluminum sheets for some of the wainscoting and ceiling below the dome. Exterior roof and side sheathing is entirely stainless steel.

The dome carlines consist of T-sections extending in one piece from side plate to side plate and the purlines are short T-sections of the same size welded between the carlines. As stated, these T-sections are carbon steel, made by cutting an I-beam of the proper size along the web center-line with a cutting torch.

Longitudinal forces in the car, as rebuilt, are carried through the dome section by means of reinforcing plates and shapes inserted in the car sides just above the windows. This reinforcement extends well ahead and back of the dome itself in order to assure a strong, rigid and permanently straight construction. The floor of the dome performs many of the functions of the roof such as tying upper portions of the sides together, also resisting torsion and latitudinal bending. Structural partitions transmit such forces from the roof to the dome floor. Longitudinal beams in the dome floor are supported by structural partitions at the ends and middle of the dome region.



Section through the Vista Dome

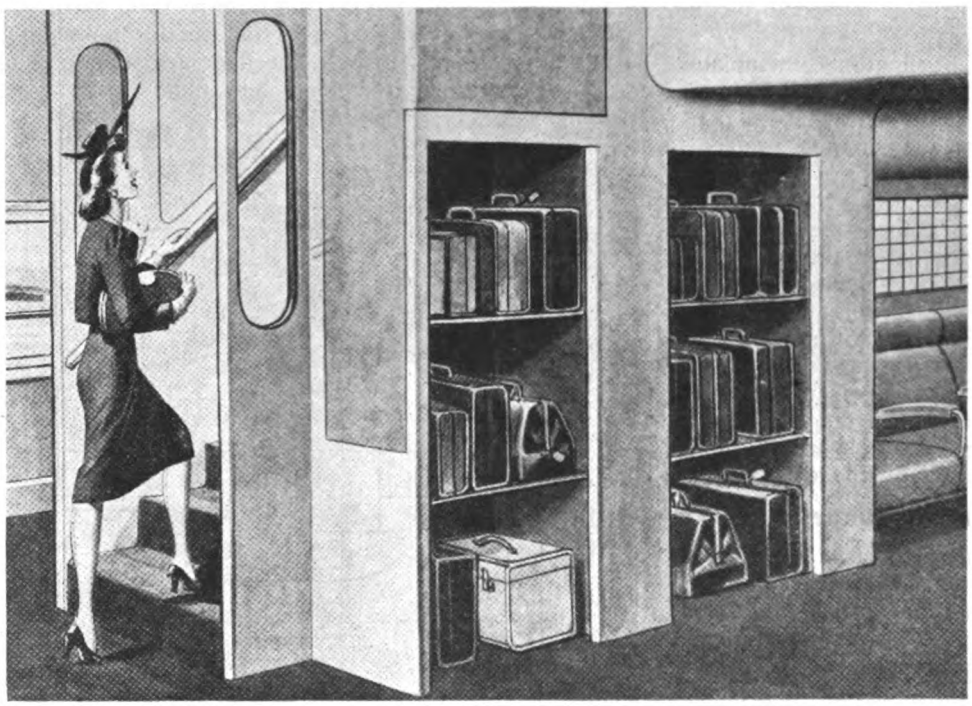


A—Women's Lounge
B—Enclosed Stairway
C—Coat Rack and Luggage Compartments
D—Twelve Longitudinal Seats and Four-Seat Card Section
E—Vista Dome Seating 24
F—Main Passenger Compartment Seating 18
G—Ovehead Luggage Rack as in Original Car
H—Men's Lounge

General arrangement of the passenger-carrying compartments of the car

Even the staircase which gives entrance to the dome is designed so that some of the step treads and risers, as well as the staircase sides, perform structural functions.

The dome compartment is thoroughly insulated with J. M. rock cork board-type insulation. Glass used in the dome consists of Libby-Owens-Ford Metl-Flex Thermopane, the front, back and top of the dome comprising



Luggage space is provided at the sides of the stairway

double laminated panes of ⅜-in. safety glass separated by a ¼-in. air-space, the outer pane having heat and sunray resisting properties. Side windows in the dome have one pane of ¼-in. heat-absorbing glass, then a ¼-in. air space and a ⅜-in. pane of safety glass on the inside. All glass is sealed in steel frames. The steel dome frame is covered on the outside with stainless steel and on the inside with a thin layer of wood, both for insulation and appearance purposes. In fact, the dome interior utilizes wood finish except for the center ceiling duct.

Light and Air-Conditioning Equipment

No change was made in the method of heating and air conditioning the front and back sections of the car. The original G.E. 20-kw. belt-driven axle generator and Exide 1000-amp. hr. battery were retained, also the original Trane 7½-ton air-conditioning unit with motor-driven 4-cylinder compressor and Trane evaporative condenser unit. The center ceiling duct in the original car was cut out at the dome section and replaced by an air-duct passing vertically upward through glass walls in the center window at the front of the dome and thence into the center ceiling duct, equipped with Aerofuse circular outlets for the cool air. Side ducts and outlets just below the window level also distribute cool air in the dome compartment. The return air duct in the dome front wall just above the floor simply transmits air to the lower car floor from which it circulates back through the car and into the overhead return duct in the usual manner.

For air conditioning underneath the dome compartment, outlets are included in the rounded ceiling panels. Positive circulation of cool air to this and all other parts of the car, especially the dome compartment, are assured by supplementing the original ¾-hp. electric-driven blower with another motor of the same size, direct connected to three blower fans, one in the ceiling and one in each side duct leading to the dome.

In spite of the increased air-conditioning load as a result of installing a glass-enclosed dome in the roof of this car, temperatures in the dome compartment during the test run were kept down to 78 deg. F. with a maximum outside temperature of 103 deg. F. To achieve this effect, however, required practically continuous operation of the Freon compressor unit while handling the peak cooling load.

Looking through a side corridor under the dome

Car heating equipment also was little changed by addition of the dome to this car. When necessary, hot air is delivered to the dome compartment through the center ceiling and side air ducts. This heat is supplemented in the usual manner by floor heat from Vapor fin-type radiation units located along the floor on each side of the dome and controlled by two Vapor thermostatically-operated heat valves.

Attractive and effective electric-light fixtures have been installed throughout the rebuilt car. In the dome compartment, there are six Luminator 6-light fixtures on each side of the center ceiling air duct, making a total of seventy-two 15-watt lamps or 1,080 watts. Aisle lamps are installed under the seats, as previously explained, consisting of five staggered fixtures with a 6-watt lamp in each. Fourteen 6-watt stairway light fixtures are also used, one on each side of every step.

Under the dome compartment, four Luminator aisle-light fixtures are installed, also 12 magnifying-lens 25-watt reading lamps, supplied by the same manufacturer and installed one over each of the longitudinal seats. This same type of light is also installed over each cross seat in the card table section.

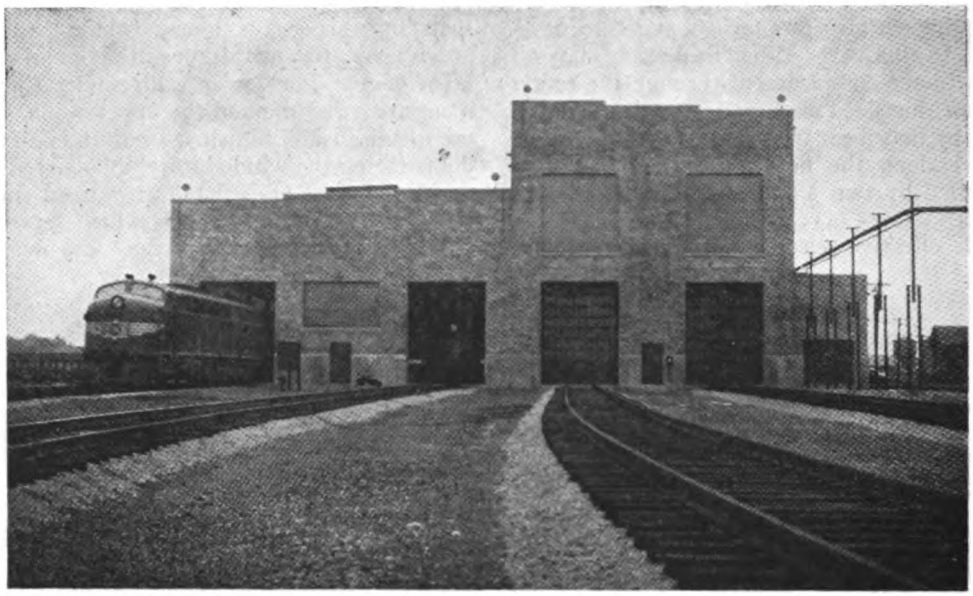
Center ceiling and baggage-rack lights are unchanged in the main passenger compartment, but important improvements have been made in the men's and women's rooms where ceiling lights have been removed and built into the curved edge of a box-like construction at the top of each wall. These lights are 25-watt and covered with attractive, curved plastic shields. The increase in lighting load from 1,550 watts in the original car to 2,664 watts in the rebuilt car necessitated installing one additional lamp regulator and 11 more light switches.

In the original coach, the chairs were upholstered in Collins & Aikman warm gray mohair. In the rebuilt car, seats and carpets for floors, including the hallways, are a peach color, window drapes in the main passenger section being blue. The lower walls under the dome compartment are a red tile and the upper walls, pale yellow paint on metal inside fiinish. Longitudinal seats under the dome facing the windows are upholstered in the same material and were consructed at Aurora shops. Above the center seats are glass panels which serve the double purpose of promoting seat privacy and desirable decorative effect. The dome compartment is finished in grey and green with a maroon carpet. The stair carpet to the top step is peach. The stairway below the hand rail is stainless steel, the upper walls of the stairway being finished in a surf green.

Looking forward in the dome—The cool-air duct in the ceiling is supplied through the double-glass wall in front of the aisle—The return-air grille is shown at the floor

Special attention was given to the men's and women's lounges, the latter being finished in a turquoise green for the built-in settee and salmon for one chair and the dressing table, the same color being incorporated in the drapes. The floor covering is a light brown Armstrong linoleum. Walls are beige cream and ceiling in the same color. White vitreous enamel lavatory and dental fountain are enclosed, with stainless steel covering all pipes. This boxed-in construction is used to conceal the pipes and provide covered space for towels. Dispensaries and other receptacles are included in the upper box construction which carries the light fixtures.

Antique tan leather is used for settees in the men's lounge, the floor being a blue-green Marbelle linoleum. The upper walls are beige and the lower walls a cinnamon brown. The same boxed-in construction of lavatory fittings is provided as in the case of the women's lounge. Light fixtures, built into the box construction at the upper side wall, as stated, utilize the rounded translucent plastic shield to give an attractive modernistic effect. All trim throughout the car is stainless steel.



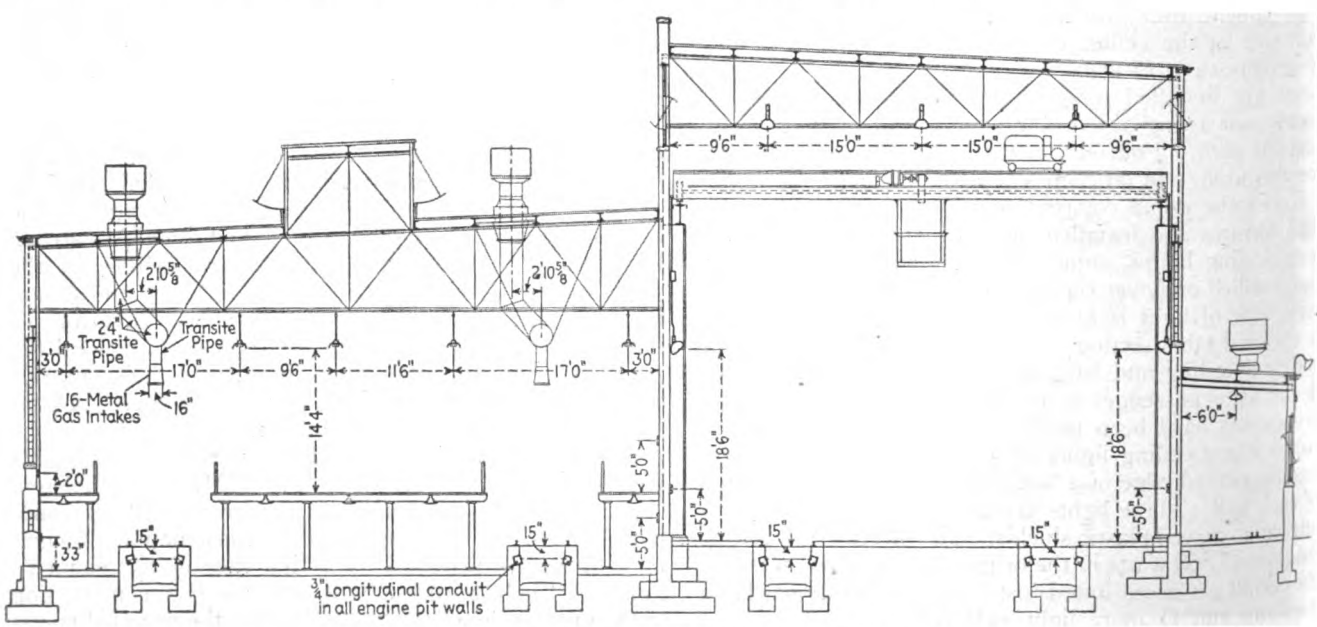
A locomotive moves into the service shop

Erie Diesel Electric Shop

Maintenance facilities for repair of electrical equipment of Diesel locomotives at Marion, Ohio show ingenious designing and practices

THE Erie Diesel-electric shop at Marion, Ohio, is characterized by numerous electrically operated automatic and semi-automatic devices which facilitate the movement of locomotives through the shop for both inspection and maintenance purposes. On the approach tracks to the shop are an entirely automatic sand handling plant, fueling facilities and automatic washer. Details of the automatic sand handling equipment with its photo-electric and pressure-switch control will be described in a subsequent article.

Having been served by these facilities, the locomotive continues on toward the shop where an electric eye starts a door opener allowing the locomotive to run into the service shop without stopping and without attendance from a ground crew. The two main sections of the build-



An elevation of the shop showing arrangement of tracks, depressed floor, elevated platform, exhaust ventilators, and location of lights

ıg are respectively the service shop and the maintenance hop.

Locomotives coming in for inspection pass through the ervice shop going out of doors at the end opposite the ntrance. Tracks in the service shop are at ground level. `he floor is depressed 33 inches below the head of the ails and the depth of the pits between the rails is 48 ıches. There is a drop pit large enough for trucks in ach track near the entrance door. A wood floor at loco- ıotive deck level is supported on columns made from crap flues.

At the exit end of the service shop provision is made or trucking across the tracks both on the floor and plat- orm level. This is accomplished by electrically-con- rolled air cylinders which swing sections of the rails out ıf the way and lower platform bridges to allow for truck-

Pit lighting in the service shop

ing and which swing the rails into place and raise the platforms when a locomotive is ready to leave the shop.

Fuel Oil

Fuel oil is pumped from the receiving point to the four 25,000 gal. storage tanks and from the storage tanks to the fueling and sanding station by two 300 g.p.m. centrifugal pumps each driven by a 10-hp. motor. At present fuel oil is delivered by highway trucks, but it will be received from tank cars when they become available for this purpose. The pump supplying the fueling station is started and stopped by remote control from the fueling station. It supplies oil through a 4-in. line and holds pressure on the four filling nozzles which allow for fueling a four-unit locomotive from one position. Constant oil pressure is maintained by a relief valve and by pass. Electrical controls and valves are so arranged that either pump may be used for fueling or for filling the storage tanks. The pumps are housed in a building 18 ft. by 20 ft. and all oil is metered.

Washing Machine

From the fueling stations, the locomotive proceeds to the automatic body washing machine. This consists of four rotating brushes on vertical shafts each driven by a 3-hp. motor and a number of perforated vertical pipes supplied through two 2-in. solenoid-operated water valves, and pipes drained in cold weather by one ½-in. solenoid valve.

The motors are each controlled by a combination line starter connected to a track relay. When a locomotive reaches a point 12 ft. from the washer, it passes an insulated joint and shunts the track relay by shorting the rails. This starts the motors and opens the solenoid valves and the locomotive proceeds through the washer at a speed of about 80 ft. per min. When it reaches a point 10 ft. beyond the washer, it passes another insulated joint which opens the rail circuit, stops the motors and closes the solenoid valves.

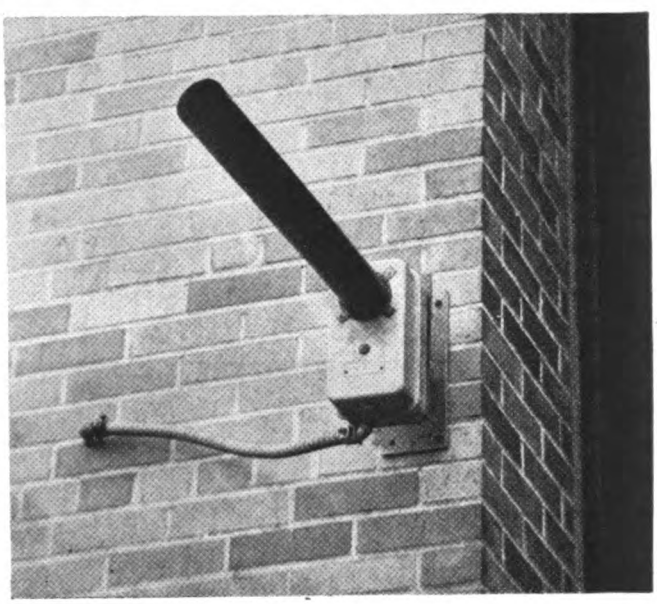
The motors are 3-phase, 480-volt, 60-cycle machines and all control apparatus has 120-volt operating coils except the four combination line-starters for the brush motors which have 480-volt operating coils.

Connections to the rails, to the track relay and to the track circuit transformer are made through a two-conductor, No. 8, Parkway cable. Power circuits are run in three-conductor No. 8, Parkway cable protected by conduit where it is run down a pole into the ground. The conduit is grounded by a driven ground and the body of the washing machine is grounded to the water line. Because of the excessive moisture, the flexible leads, including a ground wire to the motors, are enclosed in water hose.

Trucks are washed with a high-pressure hand hose and nozzle at the fueling station and the ends of the locomotives are washed by hand in the service shop.

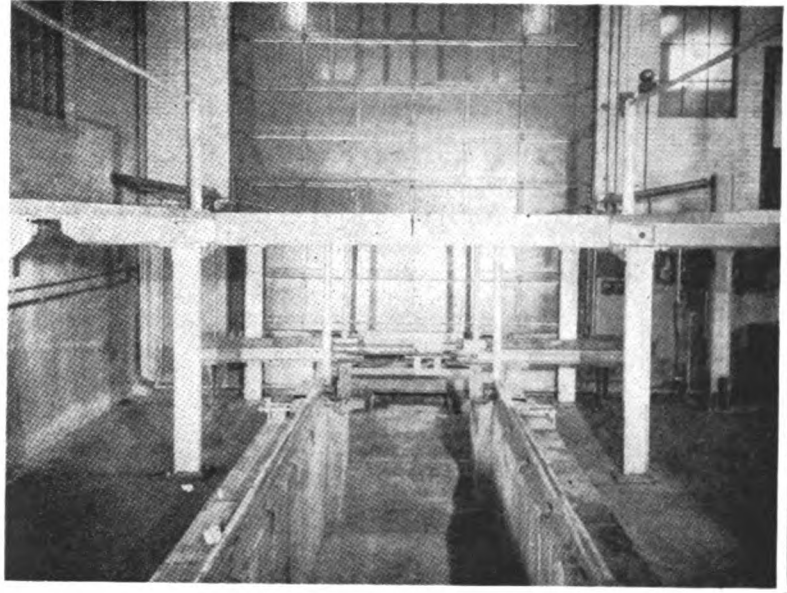
Automatic Door Openers, Rail Closers and Bridge Operators

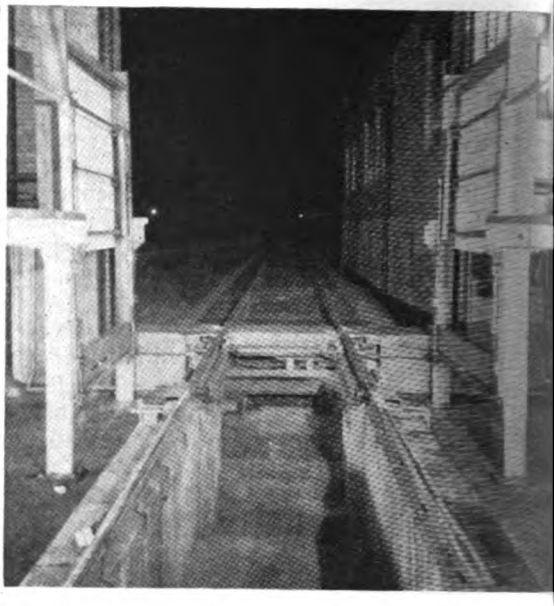
From the washer, the locomotive proceeds along a slightly curved track to one of the two doors in the service shop. At a distance of about 200 ft., the headlight beam falls upon a photo-electric relay which starts a door-opening device driven by a 1-hp. motor. When the



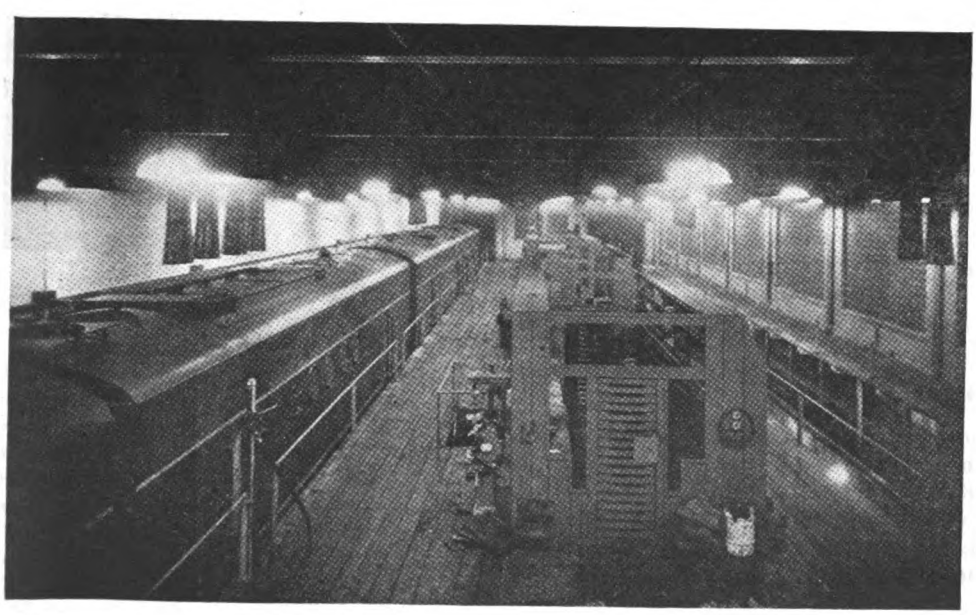
One of the photo-electric relays which operates an inbound door in the service shop

door rises to full open position, a limit switch stops the motor. The photo-electric relay is protected from operation by the daylight by a tube about 18 in. long. The headlight beam shines into the tube and operates the relay. Daylight will not operate the relay even when it is so bright that the light from the headlight can not be seen against the wall. The doors are closed from a push button station in the shop after the locomotive is inside. The doors are usually left open in warm weather.

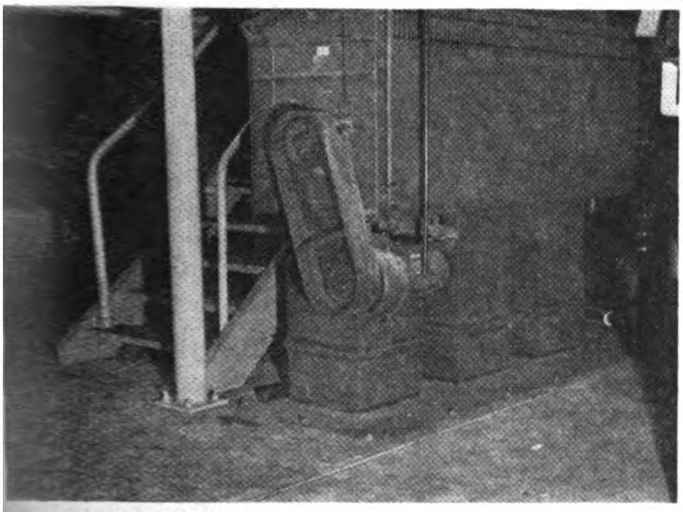




Upper left: Outbound door of the service shop showing rail sections swung to each side and elevated platform bridge in place to permit cross —Upper right: Out-bound door open with rails in position and platform bridge raised to clear way for a locomotive



Above: The repair shop is lighted by fifty-six 400-watt high-intensity mercury lighting units—Left: Interior of the service shop as it appears at night under fluorescent lighting

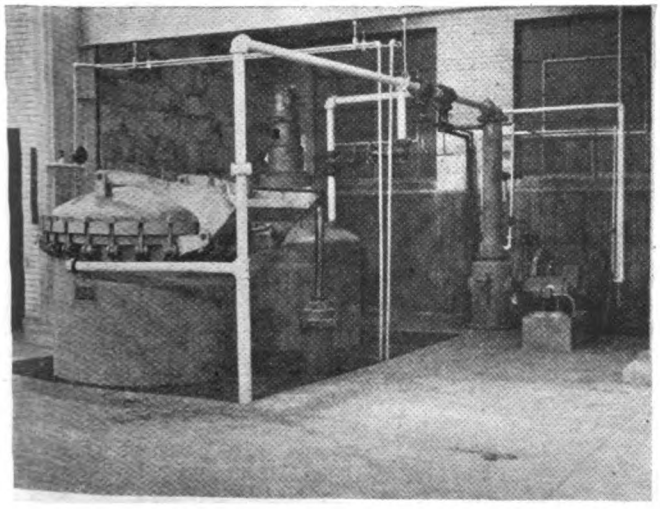


One of the heating units in the service shop

When the locomotive is spotted in the shop for inspection, motor-driven exhaust ventilators match the exhaust outlets on the locomotive and a pillar-mounted push-button station is adjacent to the side window at the engineman's position. When the inspection is complete and the locomotive ready to leave the shop, the engineman reaches out of his cab window and presses the top button on the pillar. This starts a bell which rings for fifteen seconds. It also causes the outgoing door to open in the same manner as the incoming door. It swings the open (hinged) sections of the track into places and raises the two halves of the deck-level jack-knife platform bridge. As soon as these three operations are complete, a green light adjacent to the door and another on the control pedestal are lighted through an interlocking circuit and the locomotive may leave.

The two sections of tracks which swing to each side to clear a passageway on the floor level are 7 ft. long. They are moved by air cylinders and control of the air is affected by solenoid valves, one for each direction, operated by push buttons. Limit switches shut off the air to the cylinders after each operation is complete. The same push buttons which operate the rails control similar air cylinders which raise and lower the platform bridges. They also control the operation of the door, though this may be kept open if desired. A second set of push buttons alongside the door perform the same functions.

The various limit switches are wired in series so that the green light circuit is closed when the shop door is all the way open, both halves of the lift platform are in the clear, and both swing rails are closed and locked. All control apparatus is operated from a 120-volt circuit, while the motors operate on 480-volts.

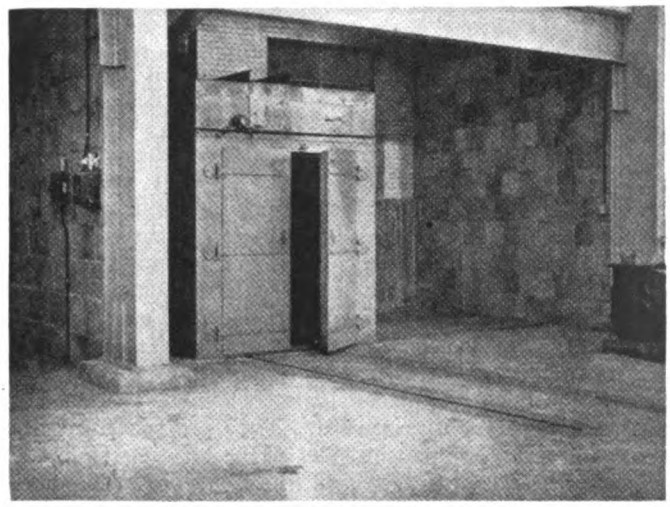


Impregnating tanks and auxiliary equipment

Lighting

The area around the fueling and sanding station is lighted by nine umbrella type standards and four R.L.M. units mounted on brackets on the structure. Each unit is fitted with a 300-watt lamp and the mounting height in each case is 15 ft. from the ground to the lower edge of the reflector. Control switches are located on the structure supporting the sand storage tanks.

The standards are made of flues and pipe. The lower five-foot section is a 5½-in. flue welded to a 12 in. square base plate which is bolted to a concrete base. A section of 3½-in. flue fitted into the lower section extends the standard to 10 ft. where the 3½-in. flue is swedged down to fit over a 2-in. pipe which supports a lighting unit with a nearby hemispherical reflector. A 6-in. by 2-in. hole near the bottom of the lower section allows for making connections between the service cable and the fixture wire. The hole is covered by a curved cover plate secured by two cap screws. Service to the standards is made by No. 12 Parkway cable.



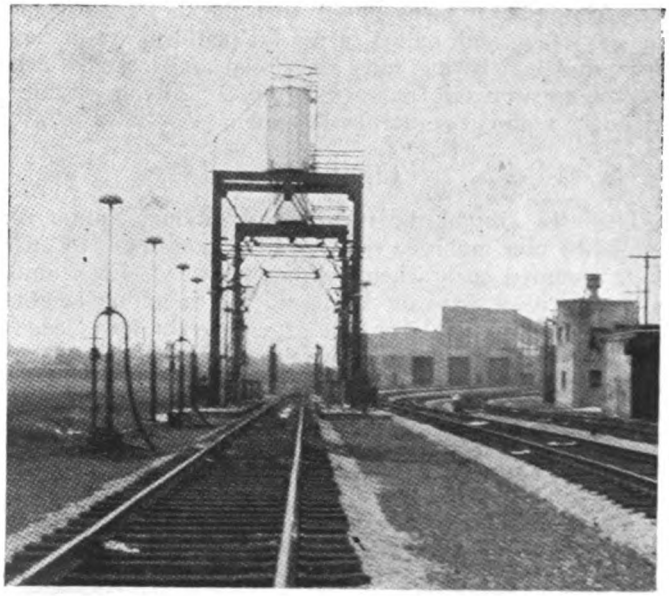
The bake oven is placed in a bay which is large enough to accommodate a second oven

The tracks approaching the shop are lighted by four 1,000-watt floodlights mounted on the roof of the shop.

Fluorescent lighting is used in the service shop above the deck-level platform. The shop, which is 220 ft. long and 61 ft. wide inside, is lighted by 54 units each consisting of two 100-watt lamps with Tulamp auxiliaries in a trough type fixture with open ends. There are three rows of lamps over the center platform and one row over each side platform. Mounting height is 14 ft. 4 in., longitudinal spacing is 20 ft. and lateral spacing is shown in the drawing. The mounting positions are made possible by suspending the fixtures from stranded steel messengers stretched lengthwise of the shop.

Under-platform lighting is accomplished with four rows of thirteen 150-watt units per row in R. L. M. reflectors mounted close to the under side of the platform. There are two rows under the center platform, one row on either side of the two tracks and six additional units in the center space.

The repair shop, which measures 49 by 220 ft., is lighted by 56 400-watt high-intensity mercury lighting



Approach track showing sanding and fueling facilities in the foreground —The washer may be seen through the framework and the shop in the background

units. Thirty of these are mounted over the crane, 40 ft. above the floor. Lateral spacing is 15 ft. and longitudinal, 20 ft. There are also mercury units in angle reflectors 18 ft. 6 in. above the floor, ten along each side wall and three on each end. All mercury units are suspended on hooks and are fitted with a short lead and plug for connection to a receptacle placed at each fixture location.

Pits in both the service and repair shops are lighted by vapor-proof units placed 15 in. below the base of the rail and tilted slightly upward. They are spaced 16 ft. apart and units on opposite sides of the pit are staggered.

Incandescent lighting is used in the cleaning room and reconditioning room at the east end of the shop, in the locker room and the lubricating oil storage room located respectively under the cleaning and reconditioning rooms and in the bays alongside the repair shop which are used for cleaning rooms, bake ovens, impregnating tanks, wheel storage, etc. Vapor-proof units are used where conditions require them.

Shop Motors

A three-phase, 480-volt, 60-cycle power distribution system is used for shop motors. Unit heaters are used for most of the heating and there are exhaust fans which draw air through the exhaust hoods over each engine location in the service shop and through the exhaust heads in the cleaning bays.

Four 5-hp. motors in the service shop drive fans in the unit heaters. Three 3-hp. unit heaters supply the repair shop and a 1-hp. heater is used in the lubricating-oil storage room and one in the parts reconditioning room. A ¾-hp. motor drives each of the eight exhaust fans in the service shop and the exhaust fans in the cleaning bay. A 1-hp. motor operates each of the four door openers. Two 3-hp. pumps in the oil-storage room and one in the service shop are used to move fresh oil and oil to be reclaimed. A fourth pump supplies distilled water which is obtained from condensate taken from the steam coils used to dry the sand. The drop pits are too low to drain into the sewer and a ½-hp. sump pump is used to move drainage water out of the pits. The two drop-table motors are rated at 20 hp. and ¾ hp.

Machines in the repair shop requiring motors are the vacuum pump for the impregnator, two engine lathes, a 20-in. emery wheel, a radial drill, and a 2-in. pipe-threading machine. Several small machines requiring fractional horsepower motors are used in the reconditioning room.

The 25-ton crane which serves the repair shop employs three motors of 5, 10 and 40 hp., respectively, operated by a suspended push-button control station from the floor. The control may be operated from the crane cab if desired.

Locomotive Maintenance Procedure

The manufacturer's recommendations covering inspection and maintenance of electrical equipment are followed to the extent that locomotive assignments permit. In addition, shop records are kept to show the history of each piece of electrical equipment. At present no rewinding is done.

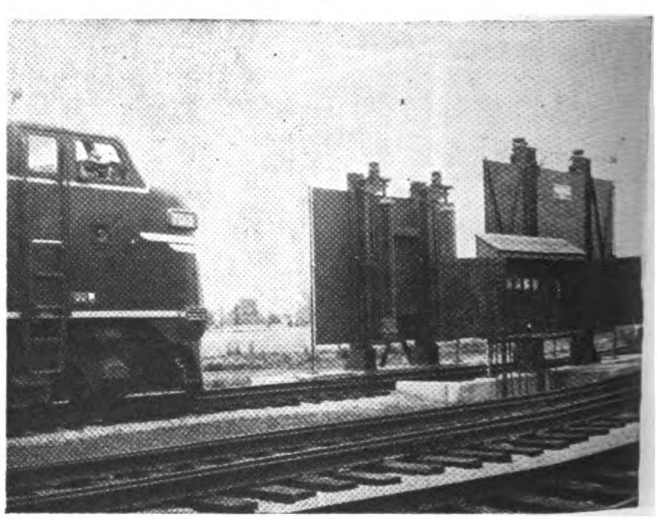
Traction motors and gears are removed in accordance with requirements as indicated by the progressive maintenance chart and motor record. The motor is meggered, completely dismantled and cleaned. Loose dirt is blown out and the armatures cleaned with cleaning fluid. If necessary commutators are turned on a lathe and undercut and any defective bands are replaced.

Armatures are then preheated in the oven, impregnated, and baked 20 hours at 135 to 140 deg. C. High potential testing is used for the annual test and for locating trouble.

Motor commutators are normally kept in condition by grinding them in place. To do this a pair of driving wheels is raised off the rail about three-quarters of an inch by means of 25-ton hydraulic jacks. One pair of brush holders is removed and replaced with a carborundum grinding fixture and the grinding is done by running the motor at a speed of about 300 rpm., with current supplied from a portable d. c. welder. The motor is blown out afterward and foreign material is cleaned out of the commutator slots with air.

This work takes about 1¾ hours and can be done on one motor during a daily inspection. The need for grinding is generally indicated from the motor record which shows rate of brush wear and breakage.

The same procedure is used on motors in trucks which have been removed from a locomotive. Generator commutators are ground by the same method, with the engine running a little below idling speed.



A locomotive approaches the washer

Western Maryland

Instruction Car

Courses in seven subjects given to operating and mechanical department employees — Demonstrations with actual working models are aids in training

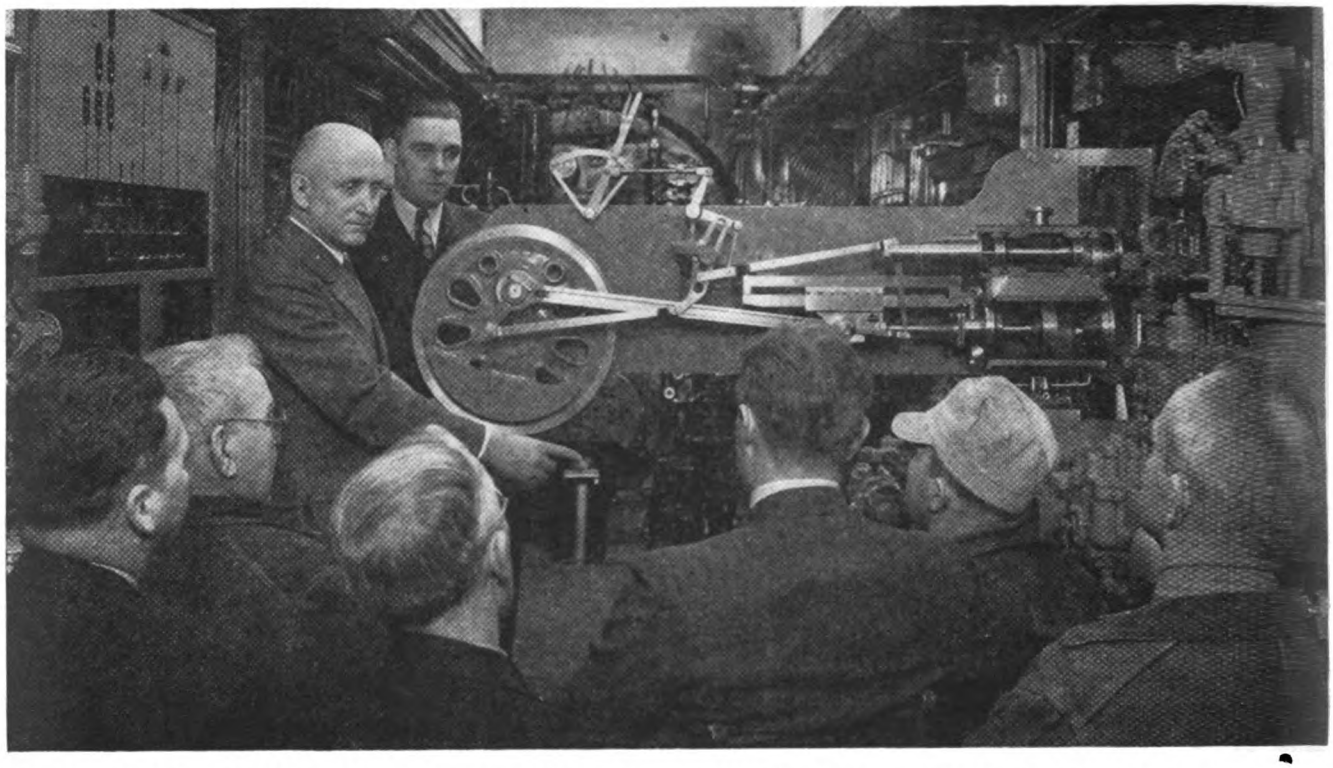
THE Western Maryland has completed and placed in service on its lines an instruction car which is used in the training of new employees and for familiarizing old employees with the operating features of new equipment installed on the road or for training them to undertake new duties. Instruction is given in seven different courses covering: air brakes; mechanical equipment on steam locomotives; mechanical equipment on Diesel-electric locomotives; fuel conservation; water treatment; signaling; and safety. Since the car has been in use approximately 200 classes have been held, the weekly average is 16, with a total of about 3,000 man lectures to date. At the present time about 75 per cent of those attending classes are men from the operating department of the road, the remainder being from the mechanical department.

The car has been divided into two sections, an office and a classroom. The instruction portion of the car is 55 ft. in length from the door entrance to the office partition. The seating capacity of this section is 34. The classroom has been finished with a cream-colored ceiling, mahogany side walls and a blue marble inlaid linoleum floor. Adequate lighting is obtained by the use of seven individual fluorescent lighting units which have a total capacity of 1,400 watts. Six exhaust fans and two air-circulating fans provide the ventilation.

A boiler backhead has been installed in the car against the partition which divides the office from the classroom section. It is complete in every detail and comparable with the backhead of the most modern types of steam power except where additional values and gauges have been applied for the purpose of demonstrating the various types of feedwater heaters being used on the Western Maryland. A small firebox, with the back flue sheet in place and equipped with tuyere-type Hulson grates is built in the interior of the boiler head. The equipment includes the elevator housing and the distributor for a standard HT stoker. A steam whistle, scaled to half-size, is located on the left side of the boiler and is operated by compressed air.

A quarter-size working model of the Walschaerts valve motion which is complete in every detail and has a sectional valve chamber and cylinder was built at the Hagerstown locomotive shop for installation in the car.

The interior of the Western Maryland instruction car



The operation of the Walschaerts gear is explained and demonstrated with a scale model—The instructor is S. M. Roth, supervisor of locomotive performance

The various types of mechanical lubricators in use on the railroad are represented in the displays as well as a protection drifting valve, a complete boiler check, a blow-off valve and a blower valve. A Nathan, a Sellers lifting-type and a Hancock inspirator non-lifting-type injector are all demonstrated. Parts of a Worthington feedwater heater and diagrammatic views of the Elesco exhaust-steam injector, Type-T, are used to explain the functioning of these specialties. Sanders, cylinder cocks, drain valves, terminal check valves and various other operating valves are all explained by the use of sectioned parts. In addition, the car carries samples of a low-water alarm, Diesel-electric locomotive parts, a Hennessy journal lubricator and a grease cellar. On a panel board are mounted miniature size signals of the types standard on the railroad. These are electrically lighted and manually operated.

Test equipment required by the water-treatment engineer is shown and its use explained. This is supplemented by the use of stereopticon slides showing the effects of scale on the interior of locomotive boilers and the beneficial results obtained from water treating. Actual demonstrations are given of the treating process.

Brake Instruction

The car is completely outfitted with locomotive and car brake equipment. Full units of the No. 6 ET and No. 8 ET locomotive brake can be operated individually with or without train brake units, the piping in the car being so arranged that one set of engine and tender brake cylinders can be used when operating either brake.

Passenger brake equipment includes the older as well as the modern types; a P-type triple valve, two L-type triple valves, and a D-22-P with a D-22-AR control valve. The older type equipment is set up with air gauges to show auxiliary and brake-cylinder pressures. The D-22 control valve is equipped with gauges showing brake-pipe, auxiliary-reservoir, emergency-reservoir, displacement-reservoir, quick-action chamber, and brake-cylinder pressures. The instruction layout also includes an air signal system equivalent to that on a 12-car train which may be operated in conjunction with either the No. 6 or No. 8 ET equipment.

There are eight freight-car air-brake units on the car, including an AB-1-B type complete with an automatic slack adjuster and quick-service valve, an AB-type valve, and six K-type valves. Gauges are used on the AB-1-B equipment to show brake-pipe, auxiliary-reservoir, quick-action chamber, emergency-reservoir, and brake-cylinder pressures. Gauges on the AB brake show auxiliary-reservoir, emergency-reservoir, brake-cylinder, and brake-pipe pressures. On the K-types auxiliary-reservoir and brake-cylinder pressures are indicated by gauges.

Four of the freight-brake units are fitted with the latest type release control retainers; two have conversion-type release control retainers, and two have the original standard double-pressure-type retainers. One passenger brake unit is equipped with the standard single-pressure-type retainers. All types of retainers are mounted on a display panel. In addition there is a single-car testing device which is demonstrated on the brake units. Piping is so arranged that either an AB or the AB-1-B brake can be separated from the rest of the brakes for demonstration testing.

Other Equipment

A sound slide projection machine is used for showing safety lectures and other educational pictures; a stereoptican is employed for the projection of diagrammatic views of equipment. In addition there are numerous wall charts illustrating features of the various specialties in use on the company's locomotives. The car, which cost $50,000, was converted at the Western Maryland's Hagerstown, Md., shops.

EDITORIALS

Temperature or Vibration?

Traction-motor maintenance has been an item of major importance on roads using Diesel-electric locomotives in passenger service. In a few cases it has been exorbitant because of improper operating practices, but even under service conditions which meet builder's recommendations there are wide variations of performance records and repair costs are generally higher than those for motors on electric locomotives. This might be construed to lack of experience, but the situation exists also on roads with an electrification background.

A fairly common source of motor failure is the breaking of coils on the commutator end and the failure of insulation at or near the end of the coil slots, also at the commutator end. An armature removed from service frequently shows a ring of powdered mica close to the end of the slots, indicating a working of the coils in the slots. This will occur even when bands are still tight.

There are two schools of thought concerning the reason for this condition. One of these maintains that it is due to the sudden heating of the copper, particularly when heavy starting currents flow through the coils of a cold armature. It is thought that the coil expands faster than the iron laminations, causing it to creep in the slot and thereby crumbling insulation and bending the end turns of the coils. A suggested means of minimizing the effects of this condition is to ease or enlarge the slots near the end of the armature to reduce the bending strains on the coils.

The second school contends that the coils are not moved by temperature differences; that heat conduction is too rapid for this to be the cause and that temperature coefficients of iron and copper are essentially similar. Rather than creep due to temperature differences, it is held that this type of failure is due to vibration, particularly that of high frequency.

Those who contour-grind gear teeth claim to have proved this theory. When gear teeth mesh, the surfaces slide until about mid-position when they roll or rock and then slide again as they pass through the latter half of the contact period. This causes the teeth to wear out of contour, leaving a hump or relatively little worn portion at the pitch circle. This, it is contended, causes a vibration of double the tooth frequency which powders insulation and which is *not* avoided by using matched gears and pinions. One road regrinds to contour while another regrinds to an arc, both also removing the ridge at the edge of wear near the base of the gear tooth. Both claim to have sharply reduced insulation failures.

Possibly both temperature differences and vibration are contributing causes and, conceivably, there are other equally important reasons. Obviously, it is a subject which requires the meeting of minds and it is to be regretted that limited association activities restrict a free exchange of opinions and discussion of operating experiences. To those who have information to extend to their associates, the pages of this magazine are always available.

Coupler Welding

In 1942 a series of tests was conducted on welded couplers which resulted in the extension of Interchange Rule 23 to permit the reclamation of cracked couplers by welding following approved procedures in both the welding and the post-welding heat treatment of these parts. The test couplers in every case received the same tests as are required of new couplers and in no instance did failures occur in the weld or near the weld zone. Among the couplers tested was one which was welded completely across the shank, with the front end of one coupler and the rear end of another being joined. This coupler too met all tests.

This year's report of the Committee on Couplers and Draft Gears contains the following statement, "While your committee recognizes that such an operation could be satisfactorily performed if properly supervised, it does not consider that a practice of this kind should be recognized or permitted under the Association's rules governing the reclamation of couplers and parts." The necessity for this ruling came about because inspectors of the Mechanical Division had found couplers completely welded across the shank in service and brought the matter to the attention of the Committee.

The Committee's judgment in this case is not being questioned. We have from time to time indicated a belief that railroad mechanical departments were not as familiar as they might be with good welding practice. This action of the Committee tends to confirm this belief because, while acknowledging that there is nothing wrong with welding couplers in this manner, it indicates a lack of confidence in the ability or willingness of the railroads as a whole to follow the procedures which insure a good job. The question which must be raised is whether the railroads (and there must be a considerable number of them) which would fail to do this work in a "properly supervised" manner are at present doing work on couplers permitted under the emergency extension to Rule 23.

The same factors which affect the quality of work on joining coupler heads and butts through the shank section by welding affect the quality of work on cracked couplers which might be reclaimed by welding. If the railroads generally are not able to do the work which the Committee failed to approve, they are most unlikely to do acceptably any of the reclamation work on couplers specially allowed by Rule 23. It would be unfair not to acknowledge that there are roads which have done much to advance the use of welding on railroad equipment and whose procedures are carefully controlled. Penalizing them by revoking the extension clauses in Rule 23 would work a hardship and be a step backward. The fact remains, however, that there is a sufficient number of roads whose practices are such that the Committee does not feel justified in taking what is a logical step forward in view of test results and its own acknowledgment. It is to be hoped that the roads whose welding practices or shop heat-treating or normalizing furnaces are inadequate will recognize their shortcomings and initiate improvements. Welding is too valuable a tool to be restricted because of misuse.

Experience With The Vista-Dome Car

The Vista-Dome car, constructed at the Aurora, Ill., shops of the Chicago, Burlington & Quincy, as described elsewhere in this issue, made its first formal run July 23 in local train No. 45 from Chicago to Minneapolis, Minn., via the scenic Mississippi river route, returning the next day in local No. 52. The next trip on July 25 and 26 was to Lincoln, Neb., and back in two fast trains, and on July 27 the car left in the Exposition Flyer for Denver, Colo., then being routed over the Moffat tunnel line of the D. & R. G. W. to Salt Lake City and the Feather River Canyon route of the Western Pacific to San Francisco. After a short run to Spokane, Wash., and back, the car returned to Chicago and has since accumulated about 10,000 miles in general revenue service.

It will be noted, therefore, that considerable experience has been acquired in the operation of this car, both in local and fast through service, in scenic and in plains country, under temperatures up to 110 deg. F. and speeds approaching 100 miles an hour. Since one of the purposes of incorporating an observation dome in a chair car was to determine the public reaction to a spectacular new feature of car design, the comments of passengers have been listed; all are favorable and, in fact, enthusiastic. During the first five days of operation, 261 questionnaires were turned in, all indicating approval of the new facility. Most of the answers to the question, "Why?" mentioned the ability to see in all directions. Many spoke of the absence of noise which is quite marked, no rail or diaphragm noises penetrating the dome or any noise from passing trains except the locomotive as it goes by. There were many references to the cool comfort under a bright sun and to how smoothly the car rides.

The car was handled behind steam power over substantial distances but this was not objectionable and in some respects is said to add to the variety of the view. Passengers riding in the dome have the privilege, many of them for the first time, of viewing the railroad right-of-way and the track structure as it approaches. They are also in an excellent position to watch the operation of signals and, when a train is doing station work or taking coal or water, they can see what is going on and do not show the restlessness often exhibited in coaches and sleepers when trains are making station stops. Still another comment on one of the questionnaires was that riding in this car is the nearest possible approach to riding in an airplane without leaving the ground. From the point of view of passenger appreciation and enjoyment, there can be little question that this new type of observation-dome construction in passenger-carrying cars is desirable and likely to be demanded in the future.

As regards practicability in operation and mechanical details of design, there are many questions still to be answered some of which will have light thrown on them by experience with the Burlington car. For example, is a depressed center sill and underframe necessary and, if so, how much space can be spared from that now occupied by air-conditioning machinery, batteries and other underneath equipment? If a straight underframe is retained, as in the case of the Burlington car, what is the best arrangement of seats or other facilities in the limited headroom area? How high is it feasible to have the dome extend above the car roof? Should seat spacing in the dome compartment be generous, or can it perhaps be reduced to 36-in. centers? How much added power will be required for the increased air-conditioning and lighting load? What change, if any, in truck design will be necessary to control car sway with a somewhat higher center of gravity?

The Burlington's Vista-Dome car is admittedly an experiment and make-shift to the extent that the observation-dome has been applied to an existing car without change in the underframe. Undoubtedly a number of changes, both in structural design and interior arrangement, would have been made had the car been designed new from the ground up. There is nothing make-shift, however, about the appearance, decorative treatment, or equipment of the car, which is modern in each of these particulars.

An exceptionally workmanlike job has been done in rebuilding this car at the Aurora shops. It not only looks like new, but has stresses carried through the dome section with reinforcing members elsewhere which are designed to develop at least the full original strength of the car. To the Burlington goes the credit for courage and enterprise in being the first railroad to determine from actual experience how much merit there may be in the observation-dome idea, and how it may best be used.

Association Work More Important Than Ever

The war is over! In those few words is written "finis" to what was probably the most trying four-year period in all the history of American railroads. Of course, our trials are not all over yet, but at least the pressure is off and we can begin to get back to a semblance of sane and normal railroading, and begin also to look to the future and plan the moves that will enable the roads to profit from the many lessons learned during the war.

There are three extremely important facts that mechanical men—indeed all railroad men—must take into consideration as we approach the peacetime era of railroad operation:

(1) There will probably not soon be a period in which railroad motive power and rolling stock will again be put to such intensive use as has been the case in the past 48 months, during which time the attention of all railroad men was on the most urgent job of getting trains over the road without having had the usual opportunity for careful observation and the recording of the whys and the wherefores of performance. Now, therefore, is the time to pause long enough to place in the record the experiences that will serve to guide us in planning future motive power and rolling stock and the facilities with which they are maintained.

(2) We are not only going to have to meet the competition of other forms of transportation that have received a mighty impetus during the war period but we are going to have to discover that the industrial giant that developed what may be our competitors in the days to come has also conceived and brought to full stature many new processes and materials that we have got to learn how to make use of in the improvement of rail transport.

(3) There will be coming back home to us thousands of men who have helped to move by rail the men and materiel with which this war was won and these same men have had the enriching experience of operating railroads in the far corners of the world under all sorts of conditions. From these men there are many new lessons to be learned and to a great extent it is from this group of men that the supervisory and administrative staffs of the future railroads will be built.

These three general statements point unmistakably to the fact that the day of rule-of-thumb railroading is gone and that the day of trained technical and scientific railroading is here. These thousands of Army railroaders have been to school and they're not going to be satisfied with things as they always have been—they're going to want to have a part in improving them. In short, these men may well prove to be the spark plug that will put the railroad industry on its toes.

If there is anything in which the railroad industry has been shortsighted it is in not encouraging technical men to enter its ranks and in not adopting a policy of having its officers and supervisors get around the country to see what is going on. If anyone has any doubt as to how far behind the railroad industry is in the general technical character of its work and the dissemination of ideas among railroad men throughout the country one need only pick up some of the operating and maintenance manuals that will no doubt be amongst the souvenirs of the many Army and Navy men who will come back to the railroads and compare them with the "standard practice" and maintenance manuals developed in the railroad industry. If one is open-minded he can not help but learn a lesson in the value of up-to-the minute information.

Without doubt one of the greatest opportunities that railroad men may have to effect a rapid concentration of the technical information that is pertinent to their work, and to get it into the record for the benefit of the entire industry, is through association work. It is to be hoped that both officers and supervisors in the mechanical department will throw the entire weight of their support to such organizations as the Master Boiler Makers' Association, Railway Fuel and Traveling Engineers' Association, Car Department Officers' Association and the Locomotive Maintenance Officers' Association. The war's end should be a signal for all such groups to move forward to greater effort. The industry needs the information in the hands of their potential members.

NEW BOOKS

AMERICAN MALLEABLE IRON. *A Handbook. Published by the Malleable Founders' Society, 1800 Union Commerce Building, Cleveland 14, Ohio. 368 pages, 5 in. by 9 in. Price, $4.00*

This handbook contains, in 26 illustrated chapters, a full discussion of the chemistry, manufacture, and use of malleable iron, based on current practice and requirements. Chapters on casting design, pattern design, and machining practice offer practical data of direct usefulness to designing engineers and production men. Physical, mechanical and engineering properties of standard, pearlitic, and alloyed malleables are set forth in other portions of the book and correlated with requirements for the product as established by the American Society for Testing Materials, the Army and Navy, and other agencies responsible for current specifications. The metallurgical process is simply explained in another chapter, and a section is devoted to engineering tables and data, including a tabular summary of A. I. S. I., S. A. E., and N. E. steels and irons of comparable characteristics. In the chapter on machining practice are tables of feeds and speeds for drilling, milling, and turning. "Design kinks" in the chapter on casting design illustrate and explain a number of short-cuts in design made possible by malleable iron.

With the Car Foremen and Inspectors

Car Inspector's Problems*

By George Schadeff

The car inspector is required to make internal inspection of freight cars, classify them for commodity loading, and card the cars accordingly. In a great many cases the doors on these cars, especially on steel cars, are almost impossible to open without a bar. These doors are not being given the necessary attention on the repair track; the rollers are not being oiled; and, when bent at the corners and rails, the doors should be repaired and not forced closed with a bar and sledge, as the inspectors do not have the time or the tools on hand in their daily inspection to repair these doors in the train yards.

Drain Pipes on Refrigerator Cars—These pipes are found by inspectors quite frequently to have shifted, allowing the salt water to run directly into the oil boxes. The pipes must be wired back into postion. The oil-box lids on these cars are not being renewed and the water from the drains has a good chance to run into the boxes, causing water boxes and eventually a hot box. The inspector believes a little more attention should be given to the above features on this equipment when cars are on repair tracks.

Bottom Outlet Valve Caps Hanging Loose—Although this defect is cardable in interchange, the inspectors are finding a great many tank cars with the caps hanging by chains on cars coming off their line and from the various industries, and some in interchange. The inspector is required to get a large wrench, replace the caps and tighten them before cars are allowed to go forward. On some cars that have been previously loaded with asphalt and other thick commodities, he is required to bad-order the car, to hold it or send it to the repair track, as the thread of the cap is filled with dirt and frozen and he does not have time to clean the threads off and replace and tighten the cap.

Hopper Doors Open on Gondola Cars—Cars coming from industry plants, off the line, enginehouse coal chutes, etc., are arriving in the train yards with hopper doors open, or only partially closed and coal not thoroughly cleaned out by the consignee, which makes it difficult to close the doors. This matter should be taken up with superintendents to handle with agents and the offenders to have hoppers closed and coal cleaned out so that doors are completely secured before being allowed to come to train yards.

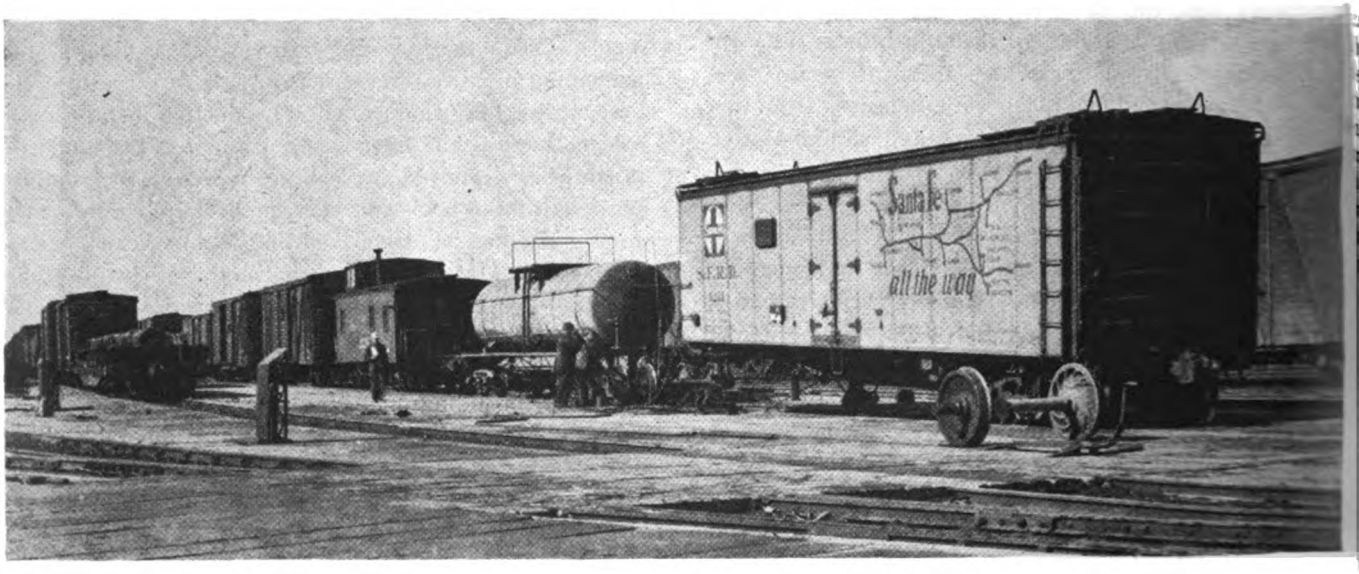
Sand Holes in Old Truck Sides—Sand holes, small checks and cracks in old-type truck sides, also badly rusted truck sides on L- and T-section truck sides have been a problem to the car inspector. Because of the shortage of time, the car inspector in many cases sets cars out with the above defects so that the cars can be given a second inspection on the repair track where more time is available, to avoid accident. We have had some serious derailments on the various railroads due to breaking down of truck sides, as some of these older cars equipped with the above truck sides are being given capacity loads during this emergency.

Defective Body Bolsters—In cases where body bolsters are cracked or broken at the side sill or outside of the side bearings, many inspectors are setting cars out under load on account of this defect for fear the car will be transferred at the next interchange point. Temporary repairs, if not permanent repairs, should be made to cars in such condition when they are on repair tracks empty.

Cars Not Properly Cleaned—When a train of empty cars (closed cars) or any empty cars come into train yards, the car inspector is required to make internal inspection, classify cars for commodity loading and card

* Excerpts from a paper presented at the March 5 meeting of the Northwest Carmen's Association at St. Paul, Minn.

† Mr. Schadeff is a car inspector of the Chicago Great Western at St. Paul.



Car repair track of the Chicago Great Western at Oelwein, Iowa

them accordingly. However, when inspectors open the doors they often find the floor completely covered with papers, refuse, straw, etc., so that it is impossible to make interior inspection, and cars must be carded either to the repair track or clean-out track for cleaning before an internal inspection can be made. This results in delay to the car. Although the Office of Defense Transportation has assisted greatly in getting the industries to clean out the cars, the consignee who unloaded the car should be required to do this cleaning.

Machinery Loads—When boxes of machinery are loaded on flat cars with high-tension holding bands, in some cases the bands do not have protection at stake pockets or knee braces to keep them from shifting. High boxes of machinery should have applied, in addition to high-tension bands, at least two anchor rods of 5/8-in. or 3/4-in. material, to give added strength to the bands.

High loads of secondhand machinery, as well as new, should carry cards showing the dimensions of the load, height from top of rail and width at top, and should be marked, if clearances have been checked to destination. This will save the inspectors time in measuring up the load in train yards.

Inflammable Placards on Box and Auto Cars—The removal of inflammable placards on box and auto cars when empty in the train yards is getting to be a difficult problem for the car inspector. The placard boards on the newer type cars are so high up that inspectors are unable to reach them without the aid of a long stick. These cards should be removed by the one who last unloaded the car, a matter which also should be handled by superintendents and local agents with the people unloading the cars.

Side-Bearing Clearance Gage

The gage, illustrated, has been developed to determine side-bearing clearance before trucks are placed under cars and thus avoid the necessity of additional jacking to make necessary adjustments in case the clearance does not come within specified limits. In other words, the use of this gage gives a positive determination of the correctness of side-bearing clearance before cars are placed on their respective trucks.

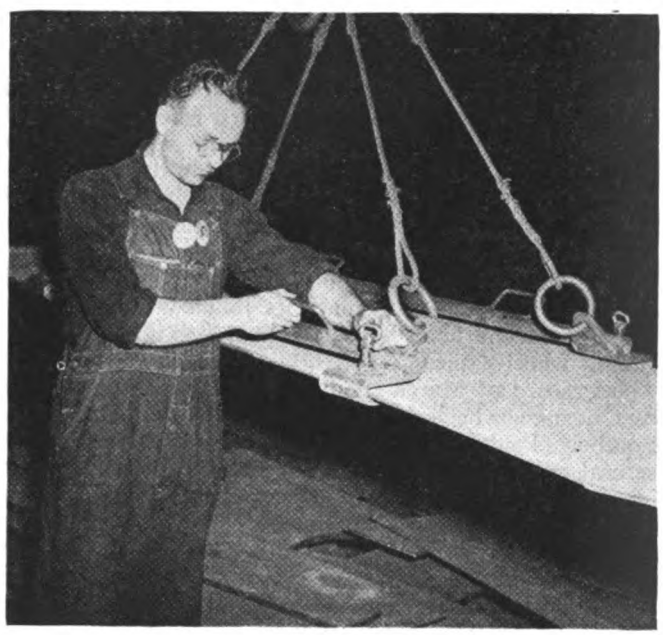
Referring to the drawing, the construction of this gage will be readily apparent. It is made of 1/4-in. by 4-in. mild-steel plate, offset 4 in., and cut long enough to space the two 5/8-in. by 4-in. end screws 50 in. on centers. Two 5/8-in. by 4-in. pins with rounded ends are welded to the central portion of the gage and a 2 1/8-in. center hole permits slipping the gage over the king pin.

In operation, therefore, the gage is applied to the male bolster center plate on the car body and the end screws adjusted until they just touch the side bearings. Keeping the gage in the same vertical position, it is then applied to the truck bolster center plate and the space between the screw heads and the side bearings will be the clearance. Having this information before car bodies are lowered on the trucks enables side-bearing clearance to be determined accurately.

Lifting Clamps Keep Plate Flat

The illustration shows set of clamps used in handling long, narrow and more or less flexible steel sheets, either singly or stacked, at the Pullman car shops of the Pullman-Standard Car Manufacturing Company.

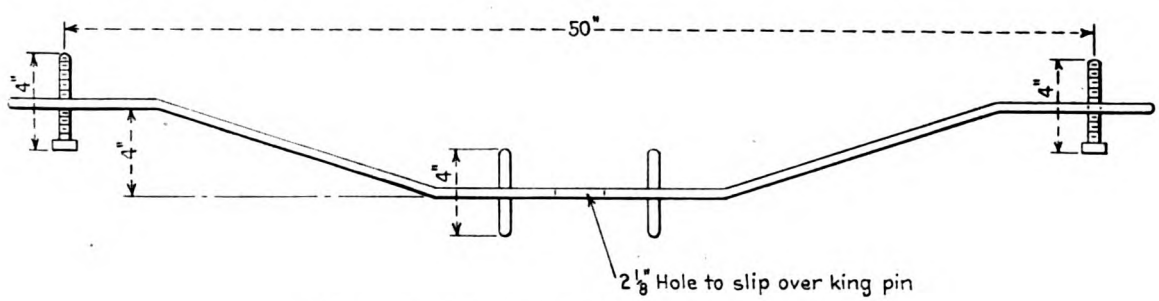
The clamps consist of two pairs of steel hooks, connected by spacing angles and equipped with four steel



Improved clamp for handling steel sheets

rings and wire slings in such a way that an upward pull by the shop crane exerts a lifting effect on the steel sheet at four well-spaced points which tends to keep the sheet horizontal and also have less tendency to buckle it than if a single pair of clamps were applied near the middle.

Each clamp, it will be seen in the illustration, is equipped with a set screw which can be tightened to prevent slipping. As originally designed, this was a hex.-head set screw which had to be tightened and released with a wrench. The improvement, submitted as a suggestion for time and labor-saving ideas by one of the shop men, consists simply of welding a small chain link



Side-bearing clearance gage which saves extra car jacking

on each of the set-screw heads so that the screw can be set up or released with the thumb and fingers. In case slightly more pressure is required than can be given by hand a 20-penny nail or the equivalent, inserted in the links, will give the needed additional leverage.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Validity of Repair Record

On January 11, 1943, the Southern Pacific exchanged wheels on car CDLX 292 and reported wheel numbers of new wheels to the owner in billing for the repairs. Again on March 26, 1943, wheels were placed in the same location in this car but the numbers of the wheels removed did not correspond to those reported to have been installed in January. The wheels removed bore manufacturers' dates several years old. The car owner requested the Southern Pacific to reduce its January billing to the value of second-hand wheels, contending that no intervening wheel exchange had been reported and that the wheel record of March should be considered as evidence that no new wheels had been applied in January. The Southern Pacific refused to do this and indicated in its refusal that twice during the intervening period the car in question had been off its lines and that the wheels in question could have been applied at one of these times by another carrier which did not notify the car owner of the wheel change.

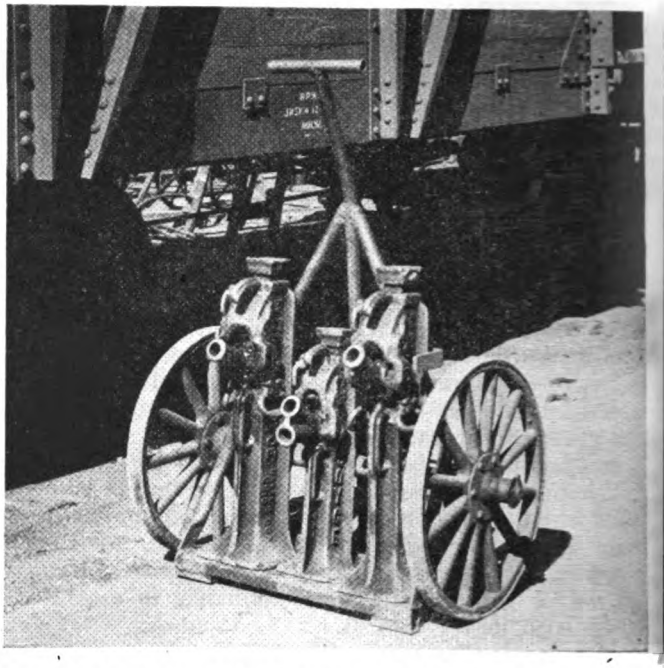
In a decision given on November 16, 1944, the Arbitration Committee said, "In view of the possibility of other wheel changes in the meantime, the billing repair card covering exchange of wheels on March 26, 1943, is not valid evidence that the identity of wheels on repair card covering exchange on January 11, 1943, is incorrect. The contention of the California Dispatch Line is not sustained." *Case 1806, California Dispatch Line versus Southern Pacific Company.*

Jack-Carrying Truck

A lightweight two-wheel truck, designed for use in handling four hand-jacks at a time about the car-repair shops and yard of the Green Bay & Western at Green Bay, Wis., is shown in the illustration.

This truck consists of a welded tubular steel frame, with a base plate on one end and a handle on the other, which is carried on two 23-in. wheels spaced 30 in. apart and located near the center of gravity of the truck when loaded with jacks. The truck moves easily although the wheels are not mounted on roller bearings but on a 1⅛-in. axle which extends all the way through a housing designed to form part of the truck frame.

The size and location of the 12-in. by 26-in. base plate is important to make the loaded truck well balanced. One lower edge is slightly further from the axle center line than the wheel radius so that when the jack has been tipped nearly to a vertical position, this edge of the base plate contacts the ground. The base plate of this truck is located with one edge 4 in. back of the axle center line and the other 8 in. ahead of it. The front edge is flanged down slightly to contact the ground and the back edge is flanged upward to keep the jack bases from slipping off. The jacks also rest against the axle housing at points near their respective centers so that, when tipped with either a single or full load of jacks in place, the truck is quite well balanced. There is no comparison between the small amount of work involved in moving hand jacks about the car repair yard with this truck and pulling and carrying them by hand. The truck is also useful in handling couplers and draft gears.



Two-wheel truck used in handling hand jacks, couplers and draft gears at the G. B. & W. car repair yard, Green Bay, Wis.

AB Brake Not Properly Maintained

The A.A.R. Mechanical Division reports in a circular letter dated August 1 that Type AB brake equipment, particularly as relates to brake-cylinder parts, are not being properly maintained in many instances. The Mechanical Inspection department has investigated the repairs of air brakes at the car and in air-brake shops and found it necessary to recommend cancellation of charges rendered against foreign line car owners for periodic attention given to Type AB brakes on several railroads thus far this year, due to failure properly to recondition brake cylinder pistons and associated parts in the shop, as prescribed by the manufacturers' instruction pamphlet No. 2391, Supplement No. 1, dated January, 1945, and as required by Interchange Rule 60.

Numerous failures properly to condition Type K brakes have also been reported, due to failure to complete all cleaning, repairing and testing in accordance with the requirements of the rule. The circular letter states that a list of all irregularities found would be superfluous as the rules governing the maintenance of air brakes are specific and complete in detail. It also requests particular

attention to conditions being found and urges that each railroad and private car owner make investigation in his own shops to see that required facilities are available and that air-brake work is being properly performed as required by the rules, instead of waiting until each individual shop is investigated by the A.A.R. Mechanical Inspection Department.

The Tank Car, Steel Soldier on the Home Front*

By J. J. Root†

The present world-wide conflict brought on by Hitler's mad lust for power and Hirohito's sneaking stab in the back at Pearl Harbor has created a greatly augmented demand for tank cars, which are now carrying, in addition to commodities previously hauled, such new products as Butadiene and Styrene, which are so important to our synthetic rubber production. Acids and Toluene used in the manufacture of explosives are also being shipped in ever increasing quantities.

Tank cars of special design with tank linings of aluminum, nickel, rubber, zinc, lithcote, etc., to resist the corrosive action of the lading, or to prevent its contamination, are now being used for the transportation of special commodities.

A large number of cars were specially converted for the transportation of component parts of 100-octane gasoline, and these cars have played a very important part in the war effort.

Due to losses and dangers to tanker transportation on the high seas, tank-car owners were asked to furnish, almost overnight, the equipment to move huge quantities of petroleum from the producing areas to meet the enormous requirements of the armed forces and of industry essential to the war effort. This accomplishment would not have been possible without the wholehearted co-operation of the petroleum industry. Vast facilities, consisting of racks, pumps, pipe-lines, loading and unloading points, were immediately installed by the petroleum industry, which resulted in a minimum of delay in the movement of tank cars. This industry likewise co-operated with tank-car owners in adjusting normal distribution practices to meet the emergency, loading and unloading tank cars twenty-four hours a day, seven days a week, and reducing the supply of cars for other purposes to the barest needs.

As an illustration of the tremendous job of transportation which is now being accomplished by tank cars in the United States, let me cite here a few almost unbelievable statistics. Every day in the week, 67 million gallons of petroleum and petroleum products are loaded into tank cars and started en route to delivery. This is more readily believable, however, when we are given to understand that during an 855-plane bomber attack on the city of Bremen, just 900 miles round trip from an English air base, one million gallons of gasoline were consumed; or that a B-29, fully loaded and using her four engines at maximum power, drinks up one gallon of gasoline a second in taking off the ground and climbing to leveling off altitude. To meet demands such as this, the United States alone produces daily 33½ million gallons of aviation gas.

There are now operating in the United States, Canada and Mexico approximately 167,000 tank cars, varying in capacity from 4,000 to 16,000 gal., of which about three-fourths are used in the transportation of essential commodities of war, and the remainder of the cars for other essential carrier needs. These cars have increased their mileage more than 400 million miles per month over pre-war movement, based on mileage figures for 1940.

Material and Manpower Shortages

The cars transferred from ordinary short-haul service to fast transcontinental movement required quick changes by the mechanical departments of tank-car companies and railroads. This, together with increased mileage, speeded-up railroad schedules, and scarcity of materials has presented serious problems in maintenance.

To further complicate the problems of maintenance, there is the serious man-power shortage, occasioned by

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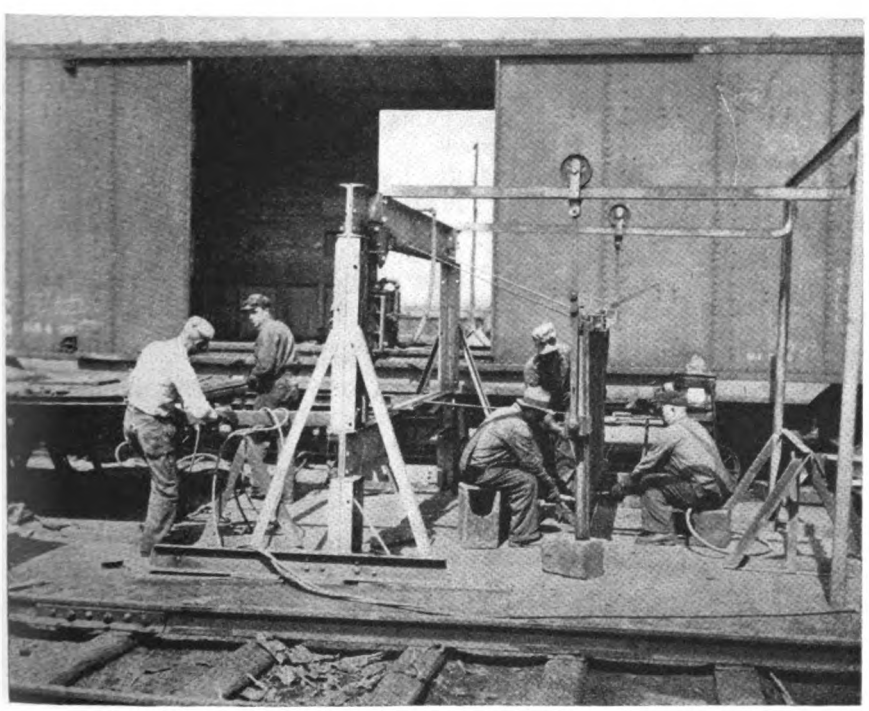
* Concluding paragraphs of a paper presented at the May 15 meeting of the Car Department Association of St. Louis.
† Vice-president, Union Tank Car Company.



Special door jig in use at a freight car repair shop for riveting work—After the doors are assembled they are moved under the uprights and mounted in the frame which has trunnions at the center—The riveting can be done with the door in an upright position and it can easily be turned over

increased production for war needs, and also that so many of our young men have left to answer the call to duty in the armed forces, making it necessary to employ new, inexperienced people in shops and offices. Many of these people are so unfamiliar with tank-cars that they were surprised to learn that a journal box is not a magazine rack, and that ICC-105-A-400 is a class of tank car and not an income-tax form.

However, tank-car operators have taken these difficulties in stride, and, with the splendid co-operation of the Association of American Railroads, the Office of Defense Transportation, the Office of Petroleum Administration for War; the War Production Board and, of course, the life lines of our nation, the railroads, these obstacles have been surmounted and have only served to add to the glory of our achievement in keeping pace with the gigantic demands of wartime transportation.

It is gratifying to be identified with an industry in which the progress of our country and the war is so directly reflected. Every step forward has been matched by improved service rendered by the tank car; and to those who have pioneered and developed this field, we are indebted for their accomplishment, which is now proving its value more than ever before.

Where in prewar days we registered annoyance at the delay occasioned by a train of tank cars blocking the road at a railway crossing, today we wait patiently while a long line of these steel, home-front soldiers speed past, for we realize that the commodities these tank cars carry represent the life-blood that will be transfused into the veins of our giant bombers and battle tanks, as well as the Diesel fuel and lubricating oil that will keep the engines throbbing in our liberty ships which are carrying supplies and replacements to Uncle Sam's brave fighting men and their allies.

Air Brake Questions and Answers

HSC Equipment on Passenger Cars and Diesel A and B Locomotive Units Brake Application

297—*Q.—With this coil energized, what happens?* A.—When the coil is energized its armature and stem is pulled down, thereby seating the lower magnet valve and unseating the upper magnet valve *161a*. Inshot air flows through choke *142*, past upper magnet valve *161a* through passages *17* and *17a* to diaphragm chamber *K*, thus balancing the inshot pressure on all diaphragms.

298—*Q.—With all lower magnet valves closed, what is the effect of additional application pressure?* A.—With all lower magnet valves *161, 161a, 161b* closed, additional application pressure from passage *16a* can build up only in diaphragm chamber *A* and act on the smallest diaphragm *60*. As the area of diaphragm *60* is 40 per cent of the main diaphragm *38*, only 40 per cent of the pressure in chamber *A* will be transmitted through the diaphragm stack to the main diaphragm.

299.—*Q.—How, then, is the build up of brake cylinder pressure accomplished?* A.—The application valve *32* and its piston *30* will be held open by lever *43* until brake cylinder pressure in chamber *F* and connected brake cylinders builds up to approximately 40 per cent of chamber *A* pressure, thus balancing the pressure on both faces of the main diaphragm.

300—*Q.—What happens at this time to bring about lap position?* A.—When the air pressure on main diaphragm *38* becomes balanced, spring *42* starts to return the piston *36*, relieving the pressure on the upper end of lever *43*. Springs *33* and *34* then seat application piston *30* and its valve *32*, and through stem *29* pivots the lever *43* at its upper end, holding the exhaust piston *25* and its valve *23* closed, retaining brake cylinder pressure and arresting the return movement of piston *36*. This is lap position in which the relay portion maintains cylinder pressure against leakage.

301.—*Q.—Explain how brake cylinder pressure is thus maintained.* A.—Any reduction in brake cylinder pressure (chamber F), will cause the greater pressure on the left of the diaphragm *38* to again open the application valve *32*, permitting main reservoir or supply reservoir air to flow to the brake cylinders until the balance is restored on the main diaphragm *38*.

302—*Q.—How does the speed governor function when train speed exceeds 20 m.p.h.?* A.—When train speed exceeds 20 m.p.h., the speed governor de-energizes the *L* magnet and spring *162a* seats upper magnet valve *161a* and unseats lower magnet valve *161a*, permitting air from passage *16* to flow through passage *17* and *17a* to diaphragm chamber *K* where it builds up on diaphragm *64*. As this diaphragm area is 60 per cent of main diaphragm *38*, the brake cylinder pressure reproduced in cavity *F* by the relay portion is 60 per cent of that in chamber *K*.

303—*Q.—How does the speed governor function when train speed exceeds 40 m.p.h.?* A.—When train speed exceeds 40 m.p.h. the speed governor energizes the *M* magnet coil, pulling down its armature and stem, which seats upper magnet valve *161* and unseats lower magnet valve *161*, permitting air from passage *16* to flow through passage *18* and *18a* to diaphragm chamber *N*, where it builds up on diaphragm *68*. As this diaphragm is 80 per cent of main diaphragm *38*, the pressure reproduced in connected brake cylinder and chamber *F* by the relay portion is 80 per cent of that in chamber *N*.

304—*Q.—How does the speed governor function when train speed exceeds 65 m.p.h.?* A.—When train speed exceeds 65 m.p.h. the speed governor energizes the *H* magnet coil, pulling down its armature and stem, which seats upper magnet valve *161b* and unseats lower magnet valve *161b*, permitting air from passage *16* to flow through passages *19* and *19a* to cavity *P* where it acts directly on main diaphragm *38*. The relay portion, therefore, reproduces brake cylinder pressure equivalent to chamber *P* pressure and laps off.

305—*Q.—What does the operation of the diaphragm stack as controlled from the speed governor provide?* A.—Provides four braking ratios of 40, 60, 80 and 100 per cent which limits the braking force in proportion to the train speed.

306—*Q.—As the train speed reduces below 65 m.p.h. how does the speed governor function?* A.—As train speed reduces below 65 m.p.h. the speed governor de-energizes the *H* magnet and spring *162b* seats lower magnet valve *161b*, cutting off supply to diaphragm chamber *P*, and unseats upper magnet valve *161b*. The air in diaphragm chamber *P* then flows through passage *19a* and *19*, past upper magnet valve *161b*, choke *138* and passage 15 to inshot chamber *C*, and through passage *15a* to exhaust valve *93*. The air in chamber *C* deflects diaphragm *85* against the tension of spring *88*, moving piston *84* to unseat exhaust valve *93*, opening passage *15a* to exhaust, *EX*. This exhausts the diaphragm chamber *P* to seven pounds inshot pressure, after which spring *88* returns piston *84*, permitting the exhaust valve *93* to be closed by spring *94*. This leaves the medium speed (M) magnet energized, which establishes the 80 per cent braking ratio on diaphragm *68*. The relay portion then operates to make a corresponding release of brake cylinder air.

Improved Sanding Facilities on G. B. & W.

An unusual feature of the improved sand-storage and sand-handling facilities of the Green Bay & Western at Green Bay, Wis., is the provision of covered storage space in conjunction with modern sand-drying equipment and a Ross and White elevated tank and delivery system for supplying dry sand to either steam or Diesel locomotives.

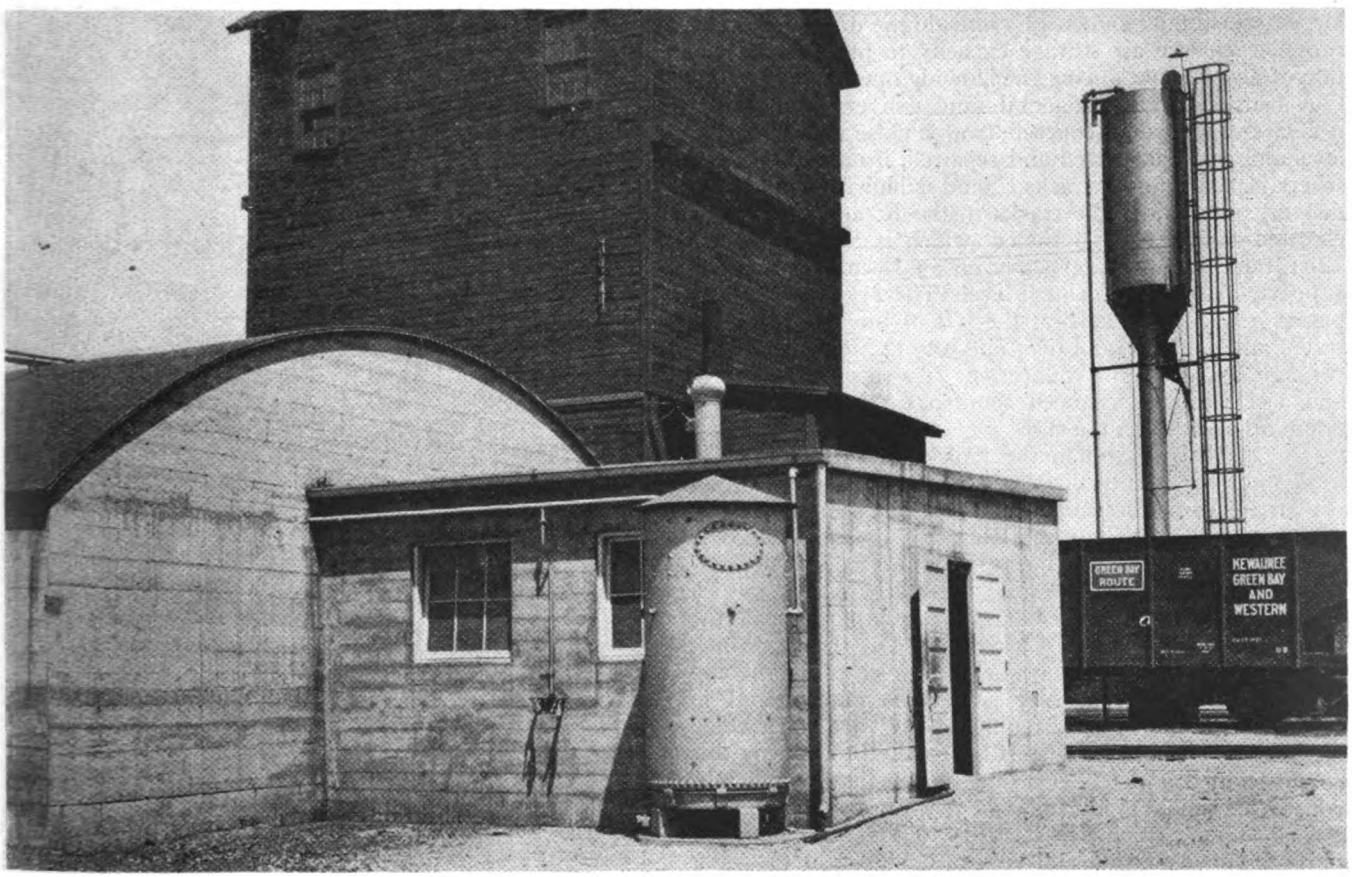
The sand-storage house, a reinforced-concrete structure, 50 ft. long by 30 ft. wide, has side walls 9 ft. high and end walls buttressed for strength and arched to support a six-section, removable truss-hatch roof. The walls of this structure are 6 in. thick, the concrete being poured on footings which extend 4 ft. into the ground. Floor slabs, covering the entire area, are 6 in. thick. The building is divided into three sections by two heavy 12-in. by 15-in. concrete cross beams at the 9-ft. level which are suitably supported by intermediate posts and serve to tie the side walls together, as well as support the main steel roof trusses.

The roof, itself, is made of ⅜-in. by 4-ft. by 8-ft. plywood panels, combined in six units or sections with a U-bolt at the center of each, so that these sections can be lifted one at a time by the locomotive crane and stacked on the ground alongside the sand house while it is being filled with sand transferred from gondolas on an adjoining track by the locomotive crane equipped with a bucket.

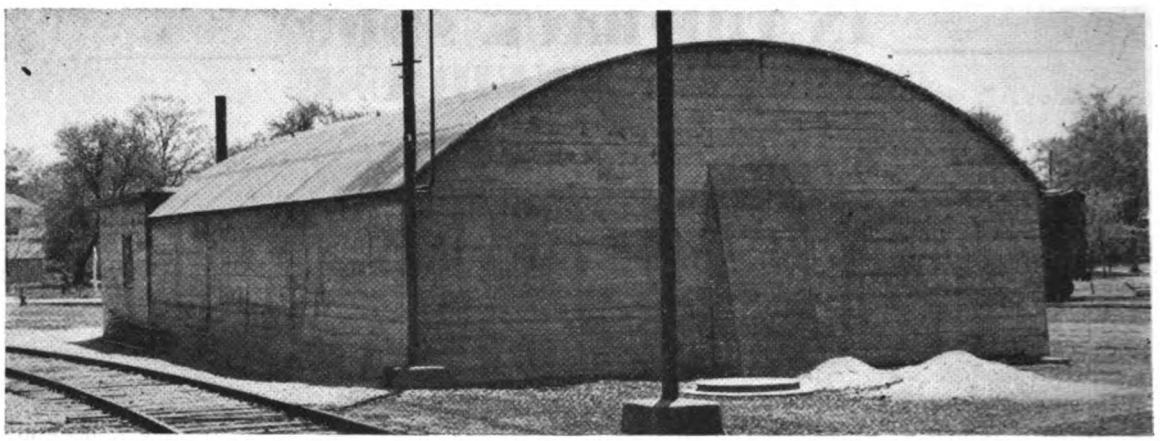
The design of the plywood roof is unique in the light but strong construction adopted. The panels in each section are held in alinement and stiffened longitudinally by 2-in. angles with ⅝-in. iron truss rods, and light wood battens unite the panels crosswise and permit them to conform to the contour of the roof. After being placed, each section is keyed in position with easily removable taper steel keys. All joints between individual plywood panels are made water-tight by the application of 4-in. fabric tape sealed with an asphalt paint. The panels themselves are protected by a water-proof paint.

Adjoining the sandhouse proper is a sand-drying house, 21 ft. by 17 ft. by 9 ft. high, also constructed of concrete and built with a slightly inclined flat roof. This part of the structure is well lighted with three six-light windows and it is entered from the outside through a double door. A wide interior door gives direct access to the sand-storage space in the main part of the building. A Pyropad sand-drying stove is installed at floor level, with an 8-ft. square by 6½-ft. deep concrete-lined pit below to accommodate the hopper and dry-sand drum, from which sand is delivered by air through a 2½-in. horizontal pipe under the tracks to the Ross and White dry-sand elevated storage tank, shown in one of the illustrations.

Referring to the close-up view of the Pyropad coal-fired stove, it will be noted that dry sand falls to an inclined ⅛-in. wire mesh screen equipped with two air-operated mechanical vibrators which agitate the screen



Sand-handling facilities on the Green Bay & Western



The concrete sand-storage house, with removable plywood roof, from the rear

and cause fine particles of sand to pass through it while large particles gradually work to the bottom and are cleaned off and disposed of periodically. Surrounding the screen is a non-skid floor plate on which the attendant stands, while firing the stove or shoveling sand from a hand wheelbarrow into the top of the stove. A small air valve near the wall is used to start and stop the mechanical vibrators.

An A. C. F. sand valve, between the floor hopper and the dry-sand drum underneath, is operated by the usual hand-pull lever conveniently located slightly above floor level. With air pressure exhausted from the drum, the sand valve is opened and dry sand permitted to run into the drum until it is practically filled to its capacity of 8 cu. ft. The sand valve is then closed and opening another air valve admits pressure to the drum and forces sand into the delivery line. A booster pipe gives added air pressure to the delivery line when required and the large vertical tank shown just outside the dry sand house provides reserve air storage capacity to prevent fluctuation of air pressure during the blowing operation.

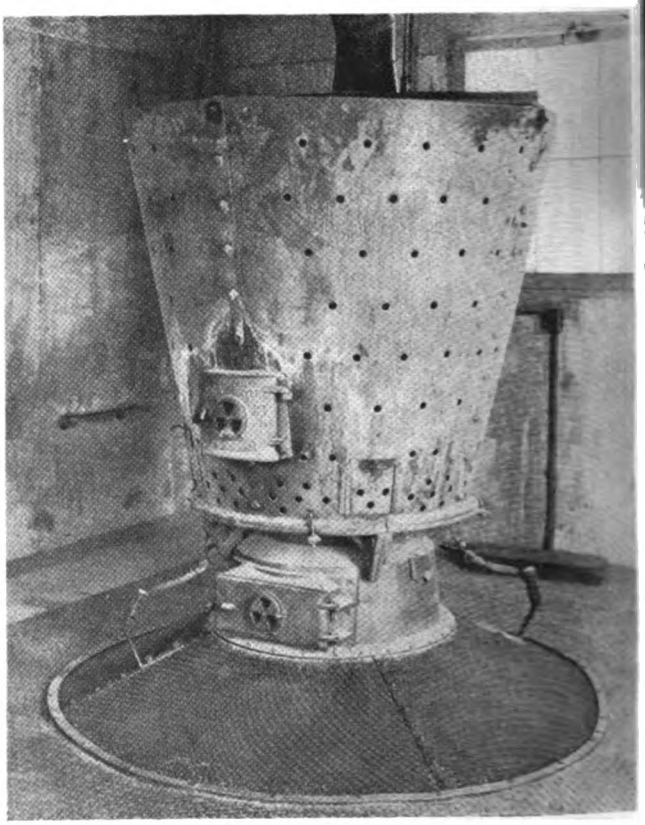
A feature of the horizontal sand delivery line is that it is laid in a covered concrete trough close to the ground level and easily inspected and repaired, if necessary, even where it passes under tracks. Sand is blown through this delivery pipe under the tracks to the R. and W. 10-ton elevated sand tank, mentioned, which is a 5-ft. dia. by 12-ft. tank, mounted vertically on an 18-in. pipe-column support, 26 ft. above ground level. The 2½-in. sand pipe passes vertically upward at the left of the tank as illustrated and delivers sand over and into the top of the tank through a water-tight connection. The usual sand valve and a telescoping balanced spout are provided, with a dome-filling hose on the end.

The height of sand in the tank is shown by a sand level indicator, easily visible to and operated by air by the attendant in the sand house. When filling the tank with sand, it is obvious that the float must not become covered up by the incoming sand, otherwise a false indication will be given. The small flexible wire rope which connects the outside level marker with the float inside the tank passes over a single-sheave pulley at the top which is fully housed to prevent water from entering the top of the tank. One difficulty sometimes encountered in severe cold weather is stiffening of the wire rope which has become wet and frozen. It is proposed to remedy this condition by completely enclosing or housing the indicator rope in a suitable pipe to protect it from moisture.

The ladder which gives access to the sand tank for purposes of inspection and repairs is shown at the right in the illustration, the protective cage being installed around the ladder for purposes of safety.

The new sand-handling facilities on the G. B. & W. have effected a marked improvement as compared with previous practice in which sand was taken from open storage space where it was often covered with snow, completely saturated with water and contaminated with dirt and cinders. Under the new arrangement, two, or possibly three times a year, the roof is removed from one half of the sand storage house nearer the track and about 12 carloads of relatively dry Mississippi river sand are unloaded into the house after which the roof is reapplied.

This sand, which is already fairly dry as well as clean, is then wheeled into the dry-sand house as required and shoveled into the stove with only a single manual handling. Comparatively little additional drying is required and then the dry, screened sand passes into the sand-delivery system ready for use. Absence of moisture avoids the possibility of freezing in the delivery line and a reliable supply of sand is available at all times. It takes



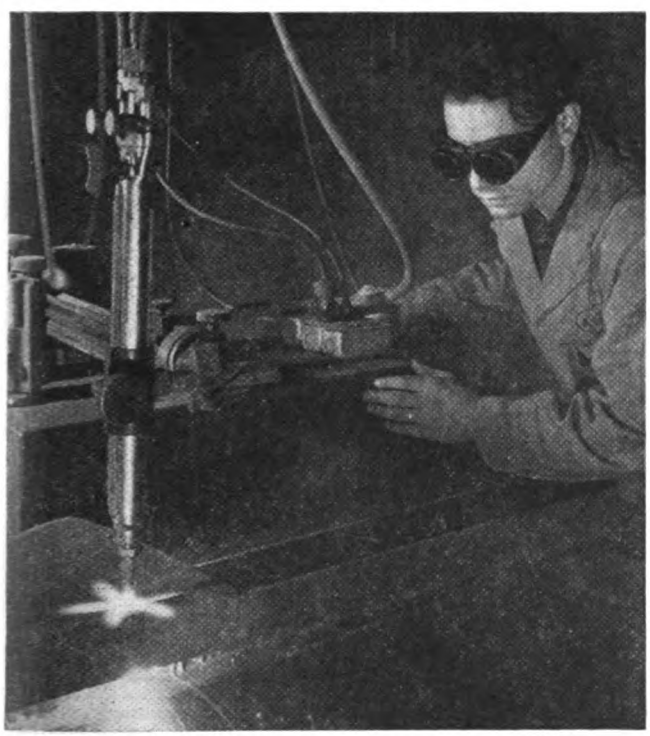
Pyropad stove in the dry room—The screen is equipped with two air-operated vibrators

only about 25 minutes for the stove to dry enough sand to fill the 8-cu. ft. drum underneath and firing and cleaning of the fire once in eight hours is generally adequate. More sand is required for winter operation than in summer and the attendant operates the sand-drying equipment and delivery system frequently enough to keep a good supply in the storage tank at all times.

Torch Cutting of Stainless Steels

Quality production of stainless steels is now possible by the use of the Airco flux-injection system which was perfected jointly by the Air Reduction Company, N. Y., and the Rustless Iron and Steel Corporation, Baltimore, Md.

One of the limiting factors in the economical fabrication of stainless steels has been an efficient production method



Stainless steel being cut on a gas-cutting machine by the use of a flux-injection system

of cutting these alloys with the oxyacetylene torch. The elements which give stainless steels their desirable properties produce oxides, when attempts are made to cut them with conventional oxyacetylene cutting equipment, which freeze and become practically impervious to the action of the cutting flame.

With the introduction of flux-injection cutting equipment, stainless steels containing as much as 50 per cent of alloying elements can be cut as readily as ordinary steels are cut by the conventional oxyacetylene method.

Every effort has been made to utilize standard type cutting equipment with the flux-injection system. The flux-injection unit weighs only about 75 lb. when fully charged and has a 35 lb. capacity, enough flux for five hours continuous operation. For hand cutting, a torch suitably adapted to deliver flux is also available. No special gas lines or similar devices are required.

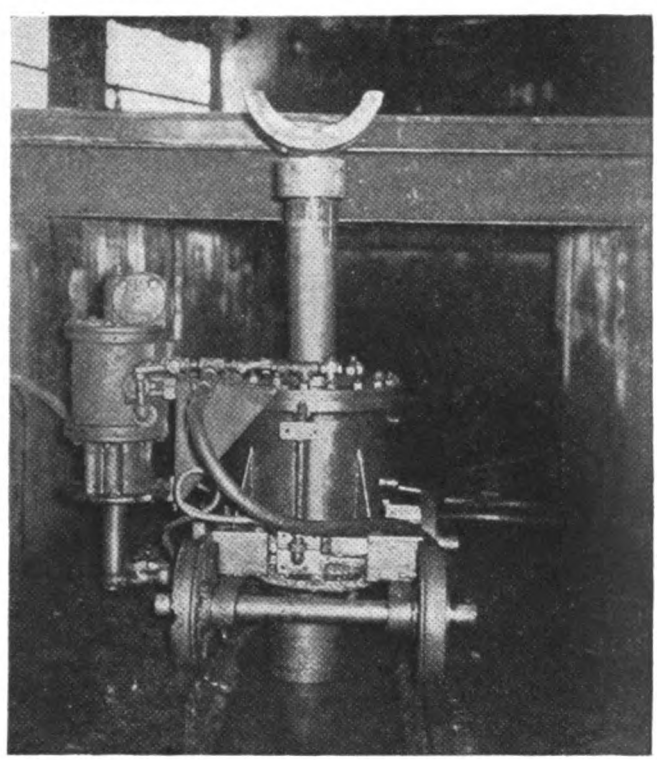
Operating conditions and instructions for stainless steel cutting are approximately the same as required for mild steel, and the speed of the cut is the same for cuts of comparable quality, whether the job calls for machine cuts or hand application. The resultant kerf is also substantially the same and flux consumption for cutting thicknesses from one to five inches averages about one ounce per minute of operation. Only normal preheat, the same as required for standard cutting operations, is required.

The flux used in the process is non-combustible and combines chemically with oxides produced in cutting stainless steels. The relatively inert nature of the flux is an important characteristic which assures trouble-free operation in the injection system and permits long-time storage. The flux flow may be regulated to any predetermined rate by the operator. Simplicity has been stressed in the flux injection and control design to assure constant free-flow in the assembly and to prevent clogging or abrasive wear in the control valves, torch or tip.

Developed originally to cut risers, increased application is foreseen for the process as quality cuts up to 3 in. and rough cuts in considerably heavier pieces up to 6 in. can be effectively made in the more popular stainless steels such as 18-8, 18-8-3, 18-12-3 and 25-12.

Converted Pit Jack

A pit jack at the Princeton, Ind., enginehouse of the Southern which is used for compressing spring rigging has been increased in capacity by the addition of a 9½-in. air pump converted for hydraulic operation. The jack formerly had a 30-ton rating but is now rated at 100 tons and has ample capacity for its intended work without any supplemental jacking or blocking. The photograph



A pit jack, the capacity of which has been increased by the use of an air pump converted for hydraulic operation

shows the unit as it appears now with the changeover made. A 1⅜-in. hydraulic cylinder is used on the pump and the speed of operation is controlled through checking the inlet and outlet ports.

Locomotive Boiler Questions and Answers

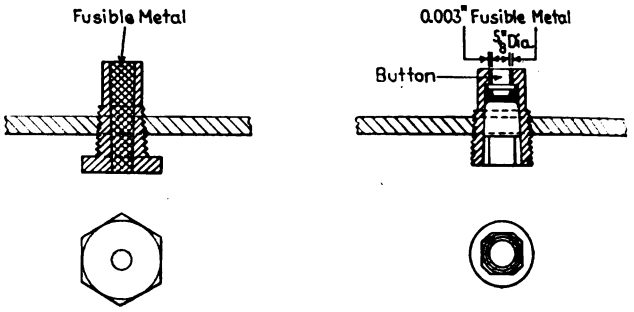
By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Boiler Plugs

Q.—What is the difference between a fusible plug and a drop plug.—C. S. M.

A.—A boiler drop plug is a fusible plug. A common type of fire-actuated fusible plug is shown on the left in the drawing. This type of plug has a tapered hole filled with a fusible metal which melts out when the crown sheet becomes overheated and allows steam and water to enter the firebox. A drop plug is a type of fusible plug which apparently derives its name from its construction. A drop plug is shown on the right in the drawing. It consists of a button cemented in place on the plug body with a fusible metal. When the fusible metal melts the boiler pressure forces the button out of the hole instantly and a full unrestricted opening for steam and water is thus obtained.



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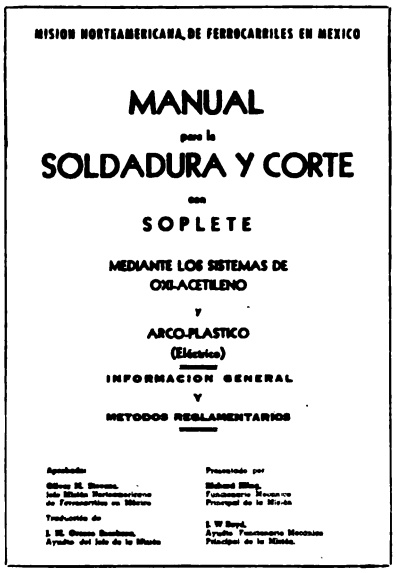

MISION NORTEAMERICANA DE FERROCARRILES EN MEXICO

MANUAL

para la

SOLDADURA Y CORTE

con

SOPLETE

MEDIANTE LOS SISTEMAS DE OXI-ACETILENO

Y

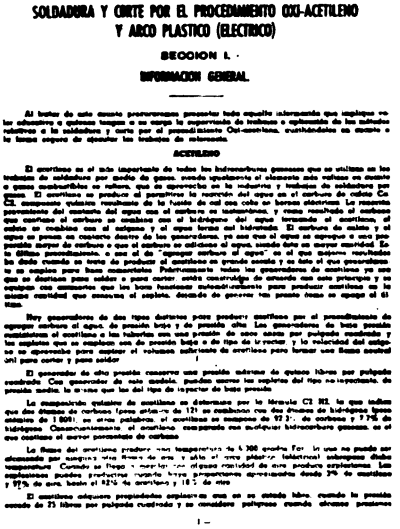
ARCO-PLASTICO

(Eléctrico)

INFORMACION GENERAL

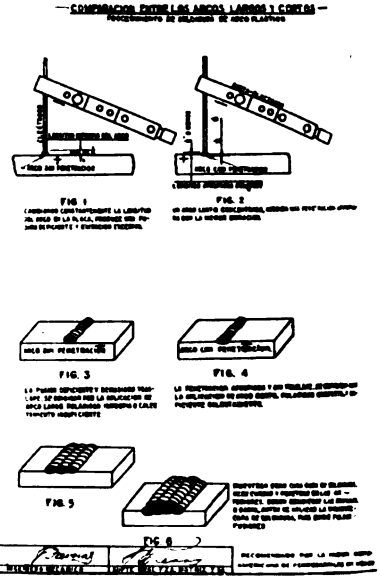
Y

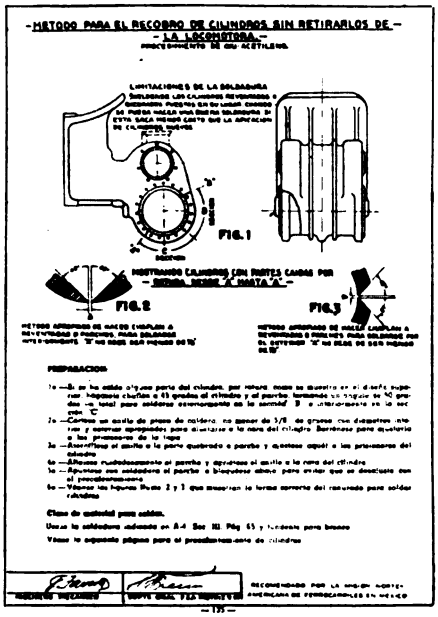
METODOS REGLAMENTARIOS

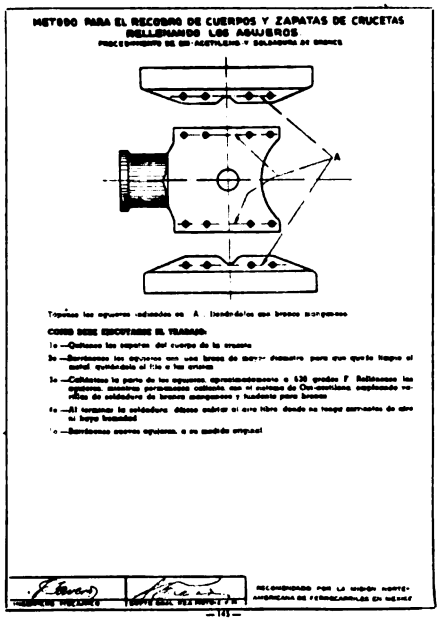

SOLDADURA Y CORTE POR EL PROCEDIMIENTO OXI-ACETILENO Y ARCO PLASTICO (ELECTRICO)

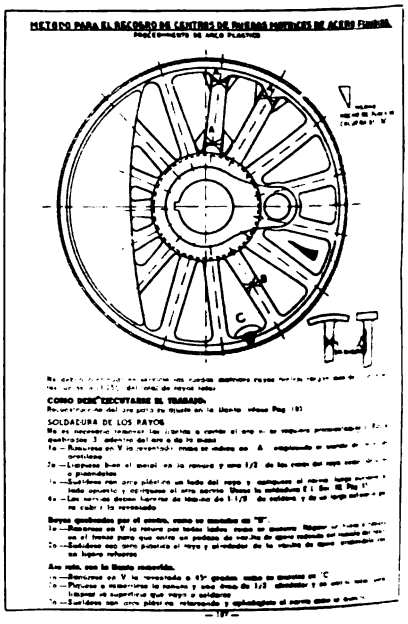
SECCION I.

INFORMACION GENERAL




METODO PARA EL RECOBRO DE CILINDROS SIN RETIRARLOS DE LA LOCOMOTIVA


METODO PARA EL RECOBRO DE CUERPOS Y ZAPATAS DE CRUCETAS RELLENANDO LOS AGUJEROS

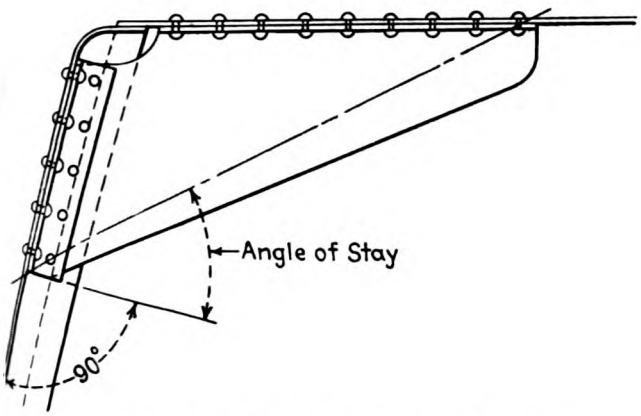

METODO PARA EL RECOBRO DE CENTROS DE RUEDAS MOTRICES DE ACERO FUNDIDO

Sample pages from the manual governing the use of welding and cutting processes on the National Railways of Mexico—The 341-page manual was prepared on the recommendation of the United States Railway Mission in Mexico—J. W. Boyd, formerly with the Baltimore & Ohio and the Western Maryland, is the supervisor of welding with the Railway Mission

Strength of Backhead Braces

Q.—In computing the strength of gusset braces for the backhead of a locomotive boiler, should any consideration be given to the angularity of the brace, as is done with the rod type of brace?—M. E. F.

A.—In calculating stresses for stays and their attachments, the angularity of the stays, if in excess of 15 deg. must be taken into account, irrespective of the type of brace used. The practice in calculating stresses on braces is to take the entire area supported by the stays, multiplying by the boiler pressure and dividing by the sum of the smallest sectional area of all the braces. This method is satisfactory if the braces are uniformly spaced. If one or more of the braces are set apart so as to receive more than a proportional share of the load they must be calculated separately. Gusset braces are calculated separately



Method for obtaining angle of the stay for gusset braces

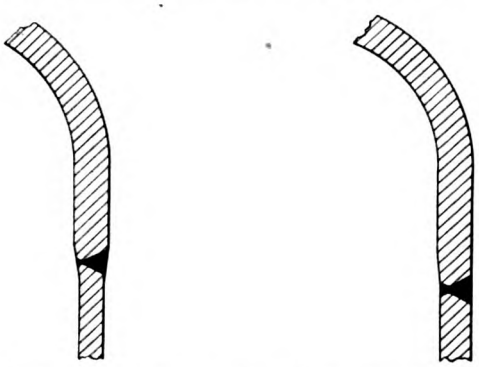
from rod braces when both types are used to brace the same surface.

The angle of each stay must be ascertained and if it is in excess of 15 deg. the area of the stay must be reduced by multiplying the area of the stay by the cosine of the angle the stay makes with a line drawn at right angles to the area supported.

Butt Welding Plates Of Different Thicknesses

Q.—When butt welding the head of a drum to the shell, if the thickness of the head is greater than that of the shell, should the edges of the head be scarfed down to the same thickness as the shell before welding?—M. O. F.

A.—The recommended practice in cases where plate edges of unequal thickness are to be joined is to trim the

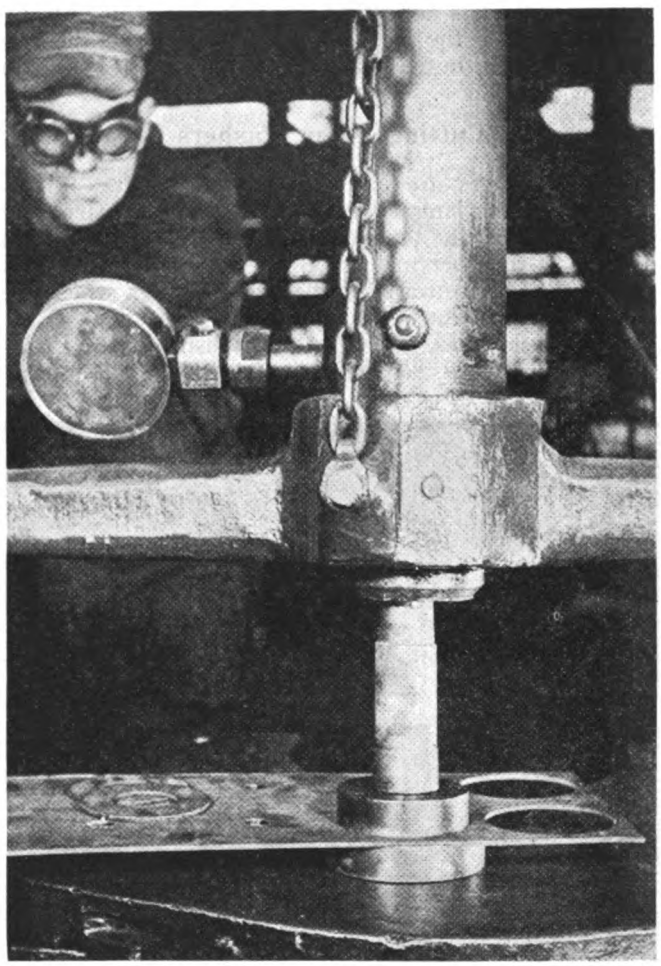


Left: Preferred method of tapering. Right: Permissible method with taper on one side of plate only

edge of the thicker plate to a smooth taper extending for a distance at least four times the offset between the abutting surfaces, so that the adjoining edges will be of approximately the same thickness. The length of the required taper may include the thickness of the weld. The preferred method is to reduce the thickness of the heavier plate by removing metal on each side. Doing this keeps the center lines of the two plates together. However, it is permissible to remove all material by tapering one side of the plate only.

Illinois Central Shop Suggestions

The Employees' Suggestion System on the Illinois Central to increase shop production and safety has brought out the two suggestions shown in this article from the Paducah, Ill., locomotive shops. Both won awards from



The dies cut fiber washers in a single operation

the railroad and also official recognition from the War Production Board at Washington, D. C.

Applying Reverse Shafts

Locomotive reverse shafts with the arms attached are notably unbalanced and awkward to handle and formerly required several men, working in conjunction with the shop crane truck, in order to apply them. What with the low headroom under the boiler barrel and danger of the unbalanced shaft turning and catching hands or fingers, the application of lift shafts was by no means an easy and safe job. With a view to eliminating the possibility of personal injury and enabling lift shafts to

be applied easier and quicker, the device shown in the illustration was developed.

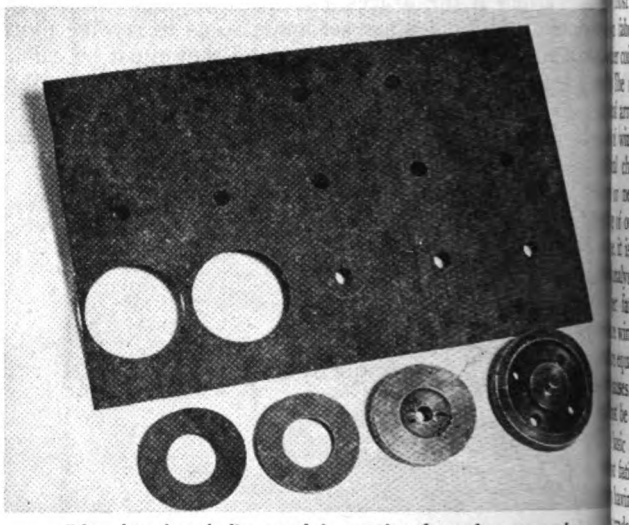
It consists of a 2½-in. steel bar, 10 ft. long with a hook welded to one end and a ring in the other which is easily attachable to the boom of the crane truck at an elevation of about 6 ft. above the shop floor. A sliding link located at about the center of the bar is provided for engagement with the crane hook and the outer or hook-end of the bar is chained to the lift shaft at approximately its center of gravity.

It is obvious, therefore, that with this device, a lift shaft can be taken from the shop floor or storage rack and, by operation of the truck crane, lifted to approximately the desired elevation and pushed in over the locomotive frame and under the boiler barrel simply by moving the crane truck in that direction. One man only is required to keep the shaft from swinging during this operation and, with a light bar leverage at the nearer end of the lift shaft, the machinist can easily keep the link support arms horizontal while the lift shaft is being pushed in over the locomotive frame. It can then be lowered in place in the bearings safely and with minimum manual labor.

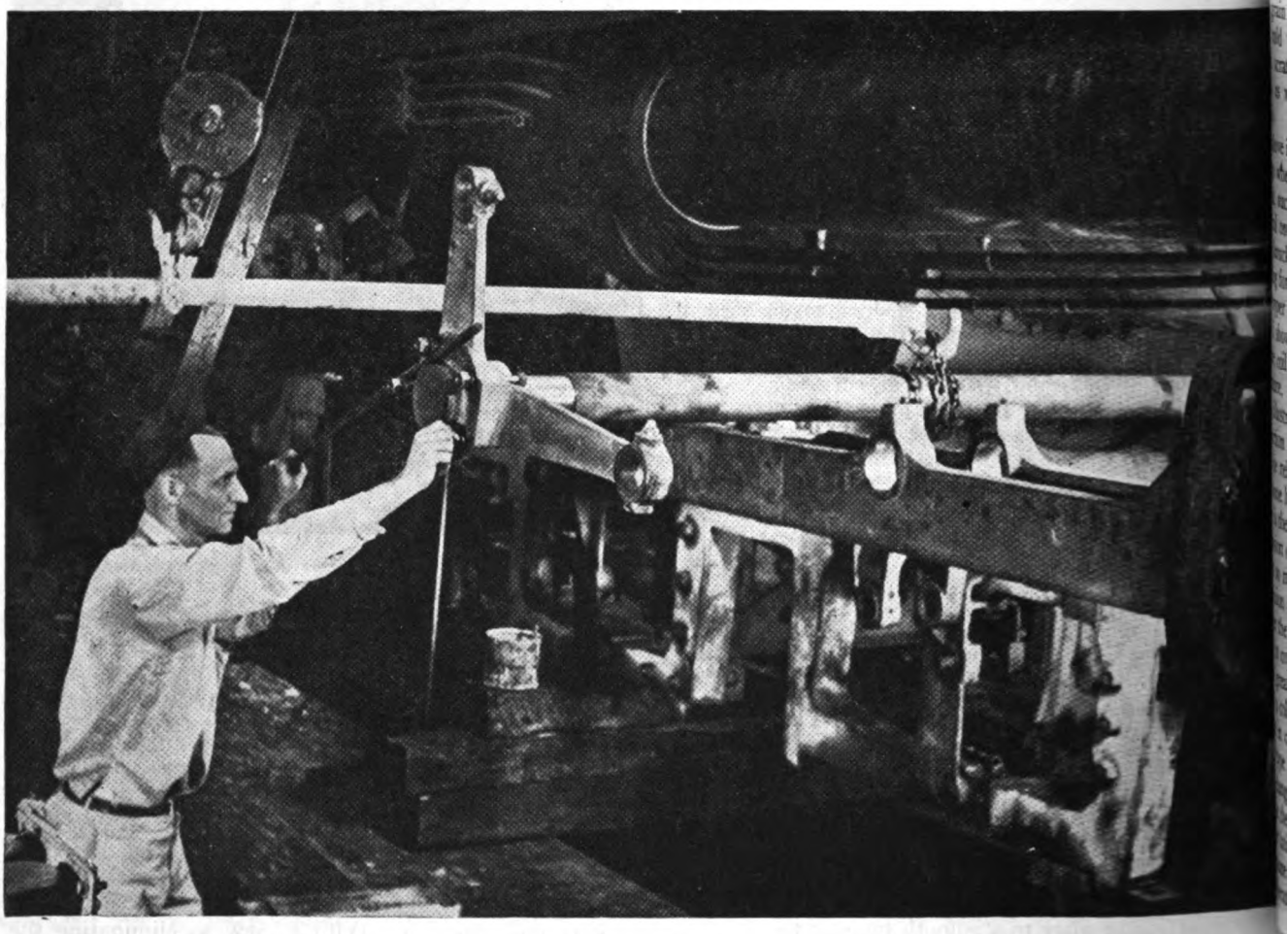
Cutting Fiber Washers

Fiber washers are extensively used on the Illinois Central to take lateral wear in valve motion parts and it was formerly the practice to lay out these washers on squares of the fiber material, then take the squares to a Do-all saw for cutting out the washer, after which the center hole was cut out on a lathe.

The special dies, shown in the illustration, are now used under a press, enabling washers to be cut quickly and accurately and with much less effort than formerly. The punch consists essentially of two case-hardened parts, a base female die and a top male die, suitably positioned with respect to the base by a pilot hole which fits accurately over a round pin in the base. The fiber board is laid out so as to avoid as much waste of material as possible and pilot holes punched in the material as shown in one of the illustrations. With the base die on the bottom, the fiber board is then inserted and adjusted until the pilot hole fits over the positioning pin. The male die is also applied over the pin and a single operation of the punch press illustrated serves to cut out the washer.



Fiber board and dies used in cutting lateral-wear washers



Device used in applying reverse shafts at Paducah locomotive shops

Rewinding Traction Armatures

By N. J. Greene, D. E. Stafford and C. Gentilini

Part II

THE most important factor to be considered in the esign, fabrication, and installation of armature and qualizer coils are copper fatigue and insulation deteriora- ion. The number of turns, span, connections, copper ize and arrangement, and minimum dielectric require- ient of windings are factors fixed for a given set of lectrical characteristics. Changed operating require- ients or need for modernization may necessitate the ltering of one or more of these factors. When such is he case, it is an electrical design problem, and complete esign analysis should be made.

Copper fatigue and the resultant wire breakage in rmature windings can be attributed to many causes, and here are equally as many devices for countering the sup- osed causes. There are, however, some fundamentals hat must be followed to minimize copper failures.

The basic copper must be of the highest quality and ie most fatigue resistant available. Several premium oppers having superior properties are obtainable under arious trade names. Soft annealed copper is generally ccepted as desirable; any severe strains set up in the opper grain structure by edge bending, swaging, and milar cold working should be relieved by annealing. urface scratching and nicking the copper must be oided, as well as excessive pounding while forming e coils.

The above is particularly true at positions in armature indings where vibration and bending forces are con- ntrated, such as at the leads back of the commutator, t the coil corners near the end of the core, and at the ips or knuckles. Prominent among the several causes f bending forces is the linear expansion and contraction f the copper wire.

Fig. 5 shows the amount of increase in length of an rmature coil bar from expansion caused by increased emperature. The dotted loop at the end of the slot ortion illustrates coil distortion at a position where a arge portion of this increased metal length is relatively ree to be relieved. After the armature body has ab- orbed some heat, the increased copper length relative to he core is then a function of the difference in coefficients of expansion of the copper and the steel of the armature. It is not so much the difference between the coefficients of expansion of the two metals that causes the trouble but rather the wide difference in their temperature. The increase in copper length from expansion relative to the core is greatest when heavy starting currents flow through a cold armature; however, there is a continual variation in coil length during operation, caused by the variable type load on traction motors.

This changing of coil length and resultant bowing of the coil at the end of the slot section not only contributes to copper fatigue but it also disturbs the coil insulation; and the same heat that causes the expansion and contrac- tion accelerates thermal aging of the insulation. In time, flexible coil insulations will be destroyed by heat and movement.

All modern traction armature windings are fabricated with Class B insulation, having an A. I. E. E. (Standard 11) temperature rating of continuous operation at 120 deg. above ambient. Often, higher temperatures are reached in operation, and the best of insulating materials are strained to their limit.

Class B insulation covers a wide variety of combinations of inorganic substances in conjunction with organic bonds and backing materials. Some maintain their flexibility after being subjected to prolonged high temperatures, while others become brittle and lose their ability to withstand movement. The backing materials normally used are organic papers and fabrics; however, in some instances inorganic paper and cloth are used. There are applications where each of the different backings may have advantages. In recent years Fiberglas cloths, some as thin as .00175 in. and .002 in., have proven highly successful for Class B backing materials. Along with the step-up in inorganic content of Class B material, we now have a new heat-stable organo-silicon oxide polymer in the form of varnishes and binders. While too early for exhaustive field tests, the performance to date on traction armature coils is most favorable, and an entirely new line of insulating materials have resulted. The temperature limits of these are in excess of present A. I. E. E. Class B ratings.

Equal in importance to the copper and insulation consideration is the proper installation and physical fit of the armature windings. The size of the slot portions must be held to a very close tolerance and must be correct for a tight drive fit without the necessity of adding filler materials. However, rather than have coils loose in the slot, it is preferable to use even organic fillers, though mica is the normally accepted material. A tight fitting coil may be driven into the slots with less hazard of damage by painting with an insulating varnish just prior to installation. The wet varnish serves as a lubricant and, after it sets, provides a bond between the coils and the core.

The coils must be shaped so that when they are installed, the pre-formed copper will lie in its normal position without setting up strains and binding points.

The point at which the coil slot section leaves the core lamination is hazardous in any winding and is even more so on railway-type armatures. The distortion from ex-

Part I appeared in the August issue.

pansion shown in Fig. 5 and the forces caused by vibration and by inertia of the end windings concentrate combined motion and pressure between the coil and the ends of the core lamination. The slots of many armatures are recessed at their ends to accommodate a U-shaped piece of heavy paper or fabric, thus affording a cushion and method of minimizing strain concentration is to taper core may not have been provided, another effective method of minimizang strain concentration is to taper the core slot from 1/32 in. to zero inches for about 1/2 in. back into the core, rounding off the outer edge.

The placement of the various insulations should be executed in accordance with carefully prepared drawings especially for the armature under consideration and made along the lines as shown in Fig. 4.

Banding

A properly cleaned and insulated armature core and the correct use of insulating materials and coils must be complemented by carefully considered banding procedure. The quality of the finished armature may be lowered, unless the same careful planning is given to the banding

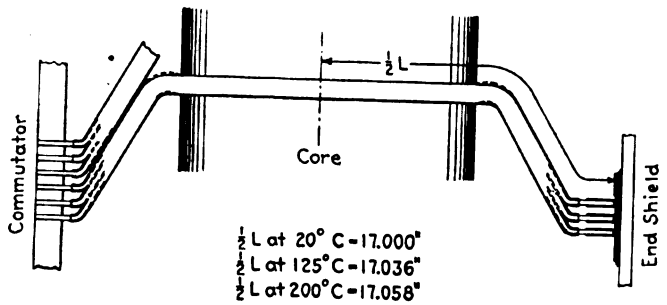


Fig. 5—Increase in length of armature coil bars from copper expansion

method, as has been followed in the other steps of armature rewinding.

To calculate the load which the bands must carry, the usual procedure is to consider as separate problems the stresses in each of three sections of the winding, i. e., the pinion end, the core section, and the commutator and section. The stresses in each of these sections can be calculated by the empirical formula:

$$S = 3.25 \times (1000)^2 \, WD$$

S = stress on the bands in lb.
W = weight of coils, including insulation and band wire in the particular section under consideration
D = armature diameter in inches
(Fore core bands use a constant of 2.8 instead of 3.25.)

After the value of "S" has been determined for each end and for the core section (except when slot wedges are used), a suitable size wire is selected. The allowable tension per wire for the wire size chosen is given in Table I. Divide this value into the stress to get the number of wires required in each band. On coil ends use double deck bands, if necessary, to accommodate the required number of wires.

Steel wire having a tensile strength of 240,000 to 270,000 lb. per sq. in. is generally used for banding armatures. However, to reduce commutation voltage and band losses, a non-magnetic band wire is desirable on higher-speed traction armatures. Non-magnetic, stainless steel wire is used in preference to phosphor bronze because of its greater tensile strength, 225,000 to 256,000 lb. per sq. in., as compared to 130,000 to 150,000 per sq. in. for phosphor bronze. The band wire must be of such quality and toughness that it can be bent 180 deg. on itself without breaking.

The anchoring of the ends of the band wire is most important, and it should be such that it will hold even after the solder may have melted and thrown off. A frequently used method of satisfying this requirement of fastening the band wire ends is shown in Fig. 6 which shows a section and a plan view. This method is principally applicable to bands on the end windings, because core band grooves normally do not have sufficient space for the double, folded-over clip. A good method for applying core bands is, first, to insulate each band groove with a layer of saturated .010-in. asbestos paper, over which is placed a strip of .015-in. tinned copper. Apply the band on the tinned copper strip, using standard, fold-over band clips, and solder to form a solid mass of band wire, copper strip, and clips.

The intermediate band clips are normally made from tinned copper and are usually spaced five or six in. apart, except at the beginning and ending of the band, at which point the clips are placed closer together. The number of clips must be an odd number that is not a multiple of any whole number divisor of the number of poles in the machine or closer than 10 per cent (more or less) of the number of poles.

Temporary "hot banding" is necessary on traction armatures to insure against lack of solidity that may lead to premature failure. Hot banding is accomplished by heating the armature to 250 deg. F. before soldering the leads into the commutator and before brazing coil connection clips where they may be used. A temporary band is run over the hot armature from the commutator riser to the pinion end of the windings. The end windings are protected with a cushioning pressboard strip under the band; and a filler strip of metal, fiber or hard wood is placed in each slot projecting above the slot.

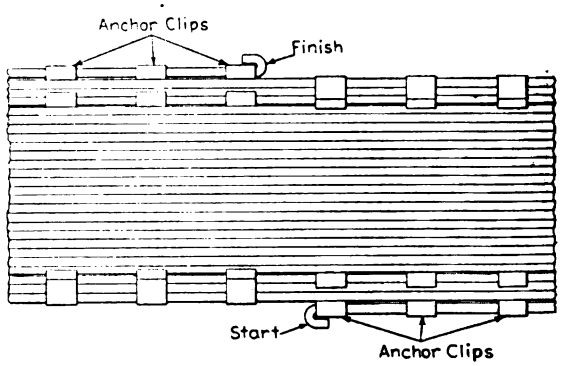


Fig. 6—Plan and sectional view of band wire showing method of anchoring

In the case of a wedged armature, install band clips so that the core portion of the temporary band can be removed for wedging with the end bands in place. After the slot wedges are in and before removing the temporary end bands, solder and braze the windings as required and then dip and bake the armature according to established standards. After the armature has cooled to room temperature, remove the temporary bands and apply the band insulation and permanent bands.

It is very important that the tension be uniformly applied. There are a number of tension devices on the market which control and uniformly apply any prescribed tension, the amount of which should not be a matter to guess. The values given in Table I have proven satisfactory.

Except on phosphor bronze band wire, a high temperature soldering alloy or high tin content solder should be used when possible. Care must be exercised to prevent annealing of the band wire during the soldering process.

and the wire should not be heated to values exceeding those below:

Phosphor bronze	450 deg. F.
Plain steel	600 deg. F.
Non-magnetic steel	1,000 deg. F.

Solders having a liquifaction point higher than 450 deg. F. should not be used on phosphor bronze band wire.

Impregnation

The proper varnish treatment ranks close to the top of the list of those things that may be done to improve the quality of a winding, and yet it is one of the least expensive to execute. Consequently, it would be imprudent to use anything but the highest-grade insulating varnish and the best method for treating and baking.

Most of the varnish manufacturers have a top-grade varnish; and while there may be many formulas for producing such a material, the generally preferred properties are: long life at elevated temperatures; deep-drying ability; only slight resoftening under heat; toughness; resistance to oil, moisture, and chemical attack; good wet and dry dielectric strength; satisfactory viscosity for proper draining and build-up; reasonably safe flash point.

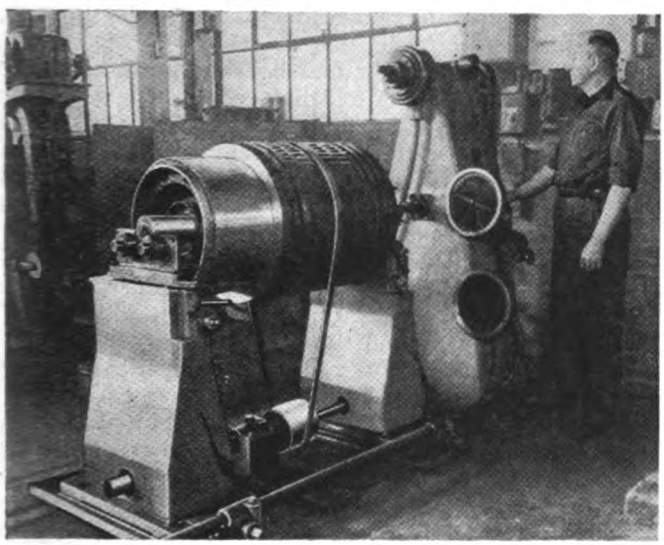


Fig. 7—Traction armature in dynamic balancing machine

Vacuum pressure impregnation is usually accepted as the best method of application for the initial treatment followed by one or two dips. The impregnating cycle may require 10 to 12 hours elapsed time, 1 hour preheat, 3 hours vacuum, 3 hours pressure, and 3 hours draining. During this treatment, the innermost parts of the winding become saturated and coated even though more than half the varnish forced in may drain or "bleed" out during baking. The additional varnish dips fill surface cracks and voids, providing a protective film over the entire winding.

A good impregnation and dip treatment bonds and solidifies the entire winding, resulting in increased heat conduction; sealing out dirt, oil, and other foreign materials; improved and prolonged life of insulation; less damage from mechanical shock, and moisture resistance.

The armature should be baked after impregnation and after each dip in a well-ventilated, preferably recirculating-air-type, oven at from 250 to 275 deg. F. The time, of course, depends upon the drying properties of the varnish, characteristics of the oven, and the physical size of the armature. A typical baking cycle for a 400-hp. high-speed traction armature with 18-in. diameter by 16-in. long core, using a high-grade synthetic varnish of general properties, shown above, is as follows:

1—Preheat in oven one hour at 250 deg. F.
2—Allow to cool to 90 deg. F. before placing in vacuum tank
3—Bake 12 hours at 275 deg. F. after impregnation
4—Bake 12 hours at 275 deg. F. after first dip
5—Bake 18 hours at 275 deg. F. after second dip.

It is usually desirable to permit the armature to cool to approximately 100 deg. F. before each dip. This procedure gives a heavier film build-up and minimizes polymerization of the heat-reactive varnish in tank.

Dynamic Balancing

Traction drives are using higher-speed motors to obtain better efficiency and lighter weight as is evidenced by the increase in peripheral speeds from 8000 to 12,000 ft. per min. during the past 25 years. Motors operating at these speeds must have precision-built, dynamically-balanced rotating members. An unbalanced armature may destroy anti-friction bearings, break armature coil leads, damage gearing, cause bad commutation, and in addition may have undesirable physiological effect.

Modern-designed rotating elements usually have provisions for fastening the dynamic balancing weights, though the methods may vary widely. Some units have grooves on both the pinion and commutator ends into which the counter balancing weights are electrically welded. Others require the fastening of the weight by bolts secured against loosening by lock plates. Practically all traction motor armatures are dynamically balanced by their maker after assembly of the spider, laminated core, and commutator, and before the application of the windings. This minimizes the amount of balancing weights required after the armature is wound and finished. Various types and designs of machines are available for dynamic balancing operations.

Table I—Banding Tension

B&S Gage	Diameter in.	Grade C steel and 18-8 stainless steel, tension, lb.	Phosphor bronze tension, lb.
8	.128	850	600
10	.102	600	400
12	.081	400	250
14	.064	250	160
16	.051	160	100

Fig. 7 illustrates a traction-type armature mounted in a balancing machine for dynamic balancing.

Experience of the operator is a large factor in the quality and cost of the operation, irrespective of the

(Continued on page 409)

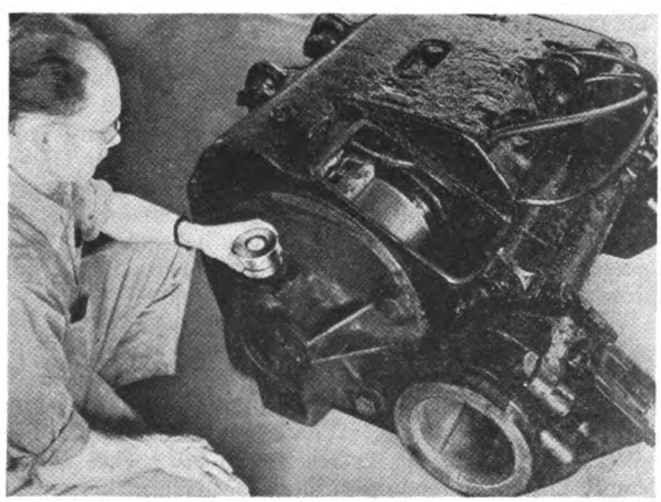


Fig. 8—Motor being checked for unbalance with vibrometer

TEST RUN

By
Walt Wyre

THERE had been no official announcement of a Diesel-electric test run from Plainville to Sanford over the mountains by way of Hillside, then across to Minertown and back over the mountains at Summit Pass, but sand-house gossip had been discussing such a run for at least a week. There had been many arguments about the feasibility of using the 5,400 horse-power Diesels over the steep, tortuous ascent of Summit Pass. A majority of the engineers discussing the idea agreed that it would not prove practical, but their opinions are sometimes based on prejudice.

Ned Sparks was moving a light over the engine-crew lineup board in the washroom when the question was being discussed by a couple of engineers. Both hogheads agreed that the Diesels wouldn't do the job, which agreement not being conducive to an argument and thus not satisfactory to engineers, one of them turned to Sparks and said, "What do you think about it, electrician; do you think the Diesels will stand the gaff pulling a drag over Summit Pass?"

"Well, I don't know exactly," Sparks replied, "but in my opinion a Diesel properly handled will pull more load up the hill quicker than one of the Mallets."

"Maybe so," the hogger said, "but what kind of shape will she be in when she gets to the top? They got plenty of power but they haven't got the guts of a steam locomotive. A damned old Mallet will keep puffing and pulling until she stalls, then spin her drivers without hurting anything, but a Diesel will burn her motors up if she stalls. At least that's what my instruction book says," the engineer added.

"That's right, a Diesel electric won't stand being stalled with the throttle open," Sparks agreed, "but I'll stick to what I said at first. If not overloaded and properly handled, the Diesel will take more tons over the hill in less time than one of the 6,000-Class Mallets that they are using."

About that time Jess Wilson, a boilermaker, came into the engineers' washroom. Jess had evidently been listening from the other side of the partition in the shopmen's washroom. The boilermaker dropped his two bits worth into the argument without delay.

"I've worked on steam locomotives over twenty years and ever since the S. P. & W. bought the first Diesels I've been watching them and the Diesels haven't got what it takes for the grind up Summit Pass. What's more," Wilson looked at Sparks as he spoke, "I'll bet you ten dollars if they make a test run the Diesel falls down."

"What do you mean 'falls down'?" Sparks asked.

"Well—" the boilermaker hesitated a moment, "I'll bet you ten dollars they have to set out part of the train if they start up the hill with full tonnage rating or within fifty tons of the rating," Wilson added defiantly.

"I'll call that!" Sparks reached in his pocket for his empty billfold, intending to bluff the boilermaker.

"I haven't got ten dollars with me," Wilson admitted, "but I'll bet you if you'll make it a payday bet."

"It's a bet!" Sparks snapped. "I can use an extra ten bucks payday. We'll just write out the terms of the bet and both sign it."

"How do you know there's going to be a test run?" the engineer asked.

"Well, if there is no test run the bet's off," Wilson said.

THREE days later, Sparks was cutting the mica down on a commutator of an electric welder armature when Jim Evans entered the electric shop. "How much do you lack having that welder ready for service?" the foreman asked.

"Oh, it'll take three or four hours to finish and get it back together," Sparks told him.

"Well, soon as you get the welder finished, you'd better go home and get a little sleep," Evans said. "They want you to go out on a Diesel tonight."

"What's the idea?" Sparks asked. "I'm not supposed to be a traveling Diesel maintainer."

"No," the foreman said, "but you've had considerable experience on them and there's no maintainer available. This is a fairly important run, too," Evans added. "It's to be a test run around the horn."

"What time is it going to get out?" Sparks asked.

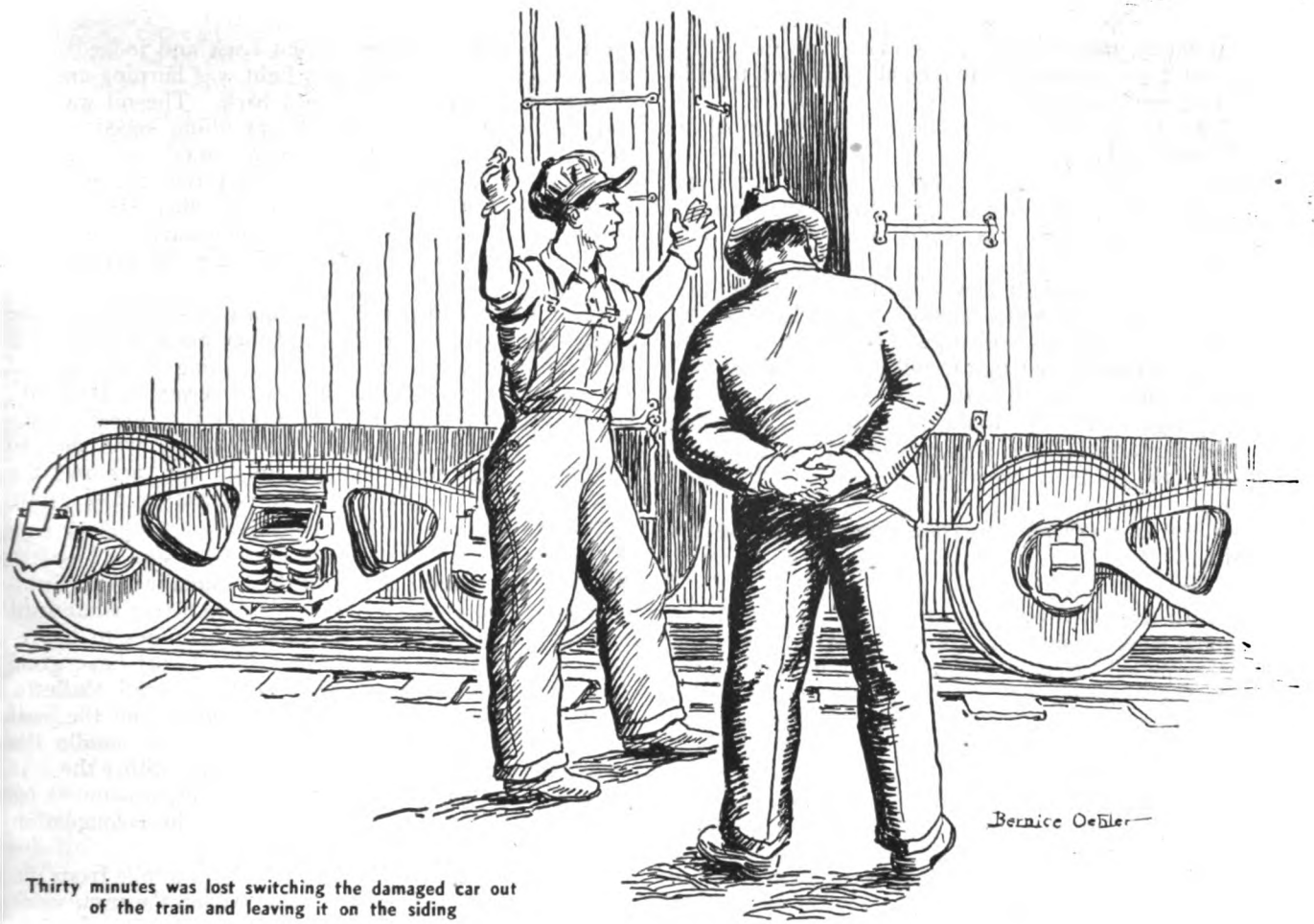
"The train is doped in here about eleven o'clock tonight," Evans told him. "They want to get it out soon as possible. I'll leave word for the caller to call you when he calls the engine crew," the foreman added as he turned to leave the electric shop.

Sparks finished the welder and went home at 2:00 p. m. Not being sleepy, he sat around until about six o'clock; then ate supper and went to bed. Unaccustomed to going to bed so early, Sparks lay there over an hour before he went to sleep. About ten-fifteen, the phone rang. "Called for 11:45 for Diesel No. 951," the caller said.

If Sparks hadn't been sleepy when he went to bed, he was sleepy then. He shook his head and opened his eyes with an effort. Then suddenly raised up and sat on the edge of the bed. The 951—he knew her well—the second oldest Diesel electric freight locomotive on the S. P. & W. and by far in the worst condition? Sparks groaned as he thought of trying to get a load up Summit Pass hill—and the ten dollar bet with Wilson. He could imagine the boilermaker grinning as he took the money.

Sparks dressed in no great rush, got his handbag that was already packed, went to the kitchen for his thermos bottle and started to make some coffee but changed his mind and decided to go to the beanery. He drank a cup of coffee and had the thermos filled for emergency, then walked across the tracks to the Diesel spur where the locomotives are serviced.

Attendants were already filling the fuel tanks. Sparks climbed up into the engine room of the No. 3 unit and placed his handbag on the bench. Before putting on his overalls he walked through the engine rooms and checked the cooling water levels. "Better fill all the water tanks," he told the attendants.



Thirty minutes was lost switching the damaged car out of the train and leaving it on the siding

"How about lube oil?" one of the men asked.

"Haven't checked it," Sparks said. "I'll check the oil soon as I get my overalls on."

Lube oil was low in two of the units and three of the cans used for carrying spare oil were empty. Sparks emptied both of the two full cans into one of the engines and told the men to fill all five cans and bring two more for the other engine in which the oil was low.

"That's more oil than they usually take," one of the men grumbled.

"Well, that's what we need this trip," Sparks told him.

THE run from Plainville to Sanford was made nicely and without any trouble. Leaving Plainville, Sparks made a couple of trips through the engine rooms noting oil pressure, cooling water temperatures, looking at all contactors to see if they were operating properly and generally looking, listening, and sniffing for indication of trouble. He found none and went to the rear cab and climbed up into the seat. Despite the uncomfortableness, he managed to take a little nap. Sleeping in the cramped position made his legs cramp and his neck stiff, but before he slept in bed again Sparks would willingly have lost the ten dollar bet for a chance to stretch out on a comfortable mattress. The run to Sanford was made in two hours and twenty-five minutes, just twenty minutes more than passenger time. Sparks had time for a cup of coffee and a roll while carmen inspected the train. Somewhat refreshed, he went back to the locomotive and climbed aboard.

The engineer was a young fellow recently promoted and none too familiar with Diesel operation. He showed his nervousness by the way his hands moved from one lever to another. When the conductor gave a highball, the engineer released the air, then, without waiting long enough for the brakes to release towards the rear of the train, opened the throttle.

"Better give the brakes time to release," Sparks cautioned.

The engineer didn't reply, but the look he gave the electrician indicated no appreciation for the suggestion.

At Lakeview they went into the siding to meet a passenger train and troop train. Sparks was in the rear cab when the engineer whistled off. He heard the hiss of air as the brakes were placed in release, then the engine started. Sparks watched the transition meter as the engineer started the train. The indicator hand went over into the red, stayed a moment, then gradually went back to normal position. There was nothing unusual in the behavior of the transition meter, such momentary overloads are usual when starting a train and do no damage.

Approaching the next telegraph station, nine miles from where they had met the two trains, Sparks heard the engineer whistle acknowledgment of a red board. Evidently the board was not lowered, for the engineer whistled again. Then the brakes were applied and the train came to a stop. Sparks walked up to the cab to see why they were stopping.

The conductor was riding the head end and when the head brakeman started to get off, the conductor said, "I'll give that operator a piece of my mind! Come along if you want to hear me bawl him out."

At that moment the operator came out. Before he had time to say anything, the conductor yelled, "What in the hell is the idea of stopping us here at the foot of a hill! A

half-wit gandy dancer would know more than that!"

"Thought you might want to take all your train to Hillside," the operator replied.

"What—!" the conductor exclaimed, as he turned his head to look back.

"Yeah, you ran off and left nineteen cars and the caboose when you pulled out of the siding," the operator said. "The dispatcher says you'd better back up and get them."

The conductor's mouth flew open like a fly trap and stayed that way nearly half a minute. "Well, I guess we'd better go back and get our train. It's so dusty along here I couldn't see far enough to tell if we had them all," he added trying an alibi for fit.

"The gauge showed the brakes were pumped off when I opened the throttle," the hogger said defensively. "Did you notice the gauge in the other cab" he asked Sparks hopefully.

"No, I was watching the transition meter," Sparks told him.

VERY little was said by the men in the cab while they were going back to get the rest of the train. They found a draw bar pulled out, bringing the end sill with it. Thirty minutes was lost switching the damaged car out of the train and leaving it on the siding. That was in addition to over an hour and a half lost stopping and going back.

At Hillside a steam locomotive was put on to help up the hill. It was almost noon and Sparks ate lunch while the train was being inspected and some switching done. The second and third units showed slightly low lube oil and Sparks added ten gallons to each of the units. Engine cooling water was getting low in the No. 3 unit. Sparks filled the unit from the reserve supply tank. It's a hard pull from Hillside to the top of the pass and Sparks wanted everything in readiness.

It was cool in the shade up in the mountains, but the sun was beaming down hot when the train pulled out. The tunnels materially increase heating, particularly of the rear units going up the hill. The fireman is responsible for engine cooling water temperature, but Sparks knew that when he had opened the shutters the fireman would make no further attempt to regulate temperatures and if the engine heat bell started ringing, all further responsibility would be unloaded on the maintainer.

The helper locomotive was doing a fair job of pushing and the Diesel was doing very nicely for its age. Cooling shutters were wide open on the two rear units but when they started through the tunnels, the temperature began to climb. Sparks knew from experience that opening the doors and leaving them open through the tunnels would do little good. Besides, the heat from the front units, dirt and smoke would fill the engine rooms, but opening the doors leaving the tunnels and closing them when entering will materially help to keep the rear units cool. That is particularly true if at the same time the rear cab doors are opened.

About two-thirds of the way up the hill, the rear unit was showing a temperature of almost 200 degrees. The third unit was only about five degrees cooler.

Sparks told the fireman, who replied, "Shutters are all open and I'm not going back there and fan them with my hat."

Sparks started to leave to go back and open the doors between tunnels when the engineer said, "We're going in the hole for a main train at Ozona. The engines can cool off then."

Just as the train pulled into the siding, the heat indicator bell started ringing. The bell continued to ring after the train stopped. Sparks went back and looked at it. The low oil pressure indicator light was burning and the oil pressure gauge had dropped back. The oil was hot and the bearings worn so that at idling speed the oil pressure had dropped to where it would not hold the oil pressure switch open. Sparks threw the isolation switch, taking the engine off the line, then stopped the engine. He waited a few minutes, then started the engine and the oil had cooled sufficiently for the pressure to stay up.

The fifteen minute wait at Ozona was sufficient for the engines to cool considerably and they made it to the top of the hill without any trouble. Going down was of course just a job of braking. The newer S. P. & W. Diesels have variable dynamic brakes that greatly simplify the braking problems, but the 951 was not so equipped. Retainers were set up on the cars and the train had to stop twice to allow wheels to cool going down the hill.

MINERTOWN is at the foot of the mountain below Summit Pass. The smoky little town had been very dead until the war caused many of the shutdown mines to be reopened. Since then many trainloads of coal have gone over the hill from Minertown. Long powerful Malletts, using full boiler pressure on all cylinders, pull the coal trains up the hill. It takes two of them to handle the one passenger train up the grade each day. Since the war increased business many-fold, more trains are routed by way of Minertown and Summit Pass to relieve congestion on the shorter line.

The train yards at Minertown are over a mile from the roundhouse and passenger station. When the train went by the passenger station, Sparks dropped off to go eat. He had just sat down at the counter when the trainmaster came in. "You are riding 951, aren't you?" the trainmaster asked.

"Yes—why?"

"Well, the train is made up ready to go," the trainmaster said. "You are going to delay it a lot waiting to eat."

"Can't help it," Sparks replied. "I've got to eat. Can I get a taxi to take me to the yards?"

"No, but hurry up and eat. I'll get my car and take you out to the yards," the trainmaster said with some irritation.

The engineer taking the engine out admitted that he had done a little running on Diesels between Minertown and Whitesboro, but not much, and the track on that division is practically level. "You may have to show me a little," he said.

The engineer, working cautiously, started the train O.K., made the proper transitions with little trouble, and did a fair job of running to the foot of the pass. There two big Mallets were put on for helpers, one near the middle of the train and one at the rear.

When the train hit the heavy grade, it began to slow down at once. As the speed decreased, the transition meter hand crept over into the red area of the meter. Sparks looked at the speed indicator. It showed slightly under fifteen miles per hour.

"What do I do now?" the engineer asked. "The meter hand is in the red."

"Drop the throttle back a notch," Sparks told him. "Seems like," he added, "that our helpers are dragging their feet."

"We never go up the hill over twelve to fifteen miles an hour," the fireman said.

When the throttle was moved to No. 7 notch the train

lowed down more and the transition meter hand started unting the red again. The engineer, long accustomed o steam, acted accordingly and opened the throttle. The wheel slip indicator light flashed and the hand went way ver into the red and stayed there until Sparks said, Close the throttle a notch. You're likely to burn up a notor or generator if you don't."

"Don't seem to have much power," the hogger said.

At that instant the alarm bell started ringing. Sparks an for the engine rooms. The overspeed trip had kicked ut on No. 2 unit, killing the engine. Sparks took the ngine off the line, started it, then, holding the lay shaft ith the tool for that purpose, brought the engine up to peed gradually. Then the engine went to idle and ne train slowed to a stop. The next thing there was a olt that almost catapulted Sparks into the low voltage use cabinet. The two helper engineers, not knowing the ead end man was going to shut off, had shoved the train p against the Diesel.

Sparks rushed to the front cab. "What's the trouble?" e asked the engineer.

"Just won't handle the load," the engineer told him. We had slowed down to twelve miles an hour.

THE head brakeman leaned out the cab window and ooked back towards the rear end of the train. "Some-ody coming this way with a lantern," the brakeman aid. "Must be the conductor wanting to know why we topped. What are we going to tell him?"

"Tell him," Sparks replied, "to tell them hogheads on he helper engine to get the lead out and stop dragging heir feet."

The brakeman climbed down from the cab and started walking back to meet the conductor.

"Maybe we had better set out five or six loads," the engineer suggested. "We are not doing any good with his drag."

"That won't be necessary!" Sparks said sharply.

The fireman was watching out the window and saw the two bobbing lanterns come closer together and stop. Then one of them gave a go-ahead. "Highball!" the fireman said.

The engineer blew two blasts of the whistle, released the air, and reached for the throttle.

"Take it easy," Sparks advised. "Don't get in a rush."

The hogger opened the throttle a notch, then another, and another. The train didn't move at once and he started to close the throttle.

"Hold it where it is a moment," Sparks said, and as he spoke the engine started slowly ahead. "Now another notch."

The train picked up a little speed. "Now drop back to the third until we get moving good."

The conductor had evidently told the engineers on the helpers because they cut in and the train went up the hill in fair shape. Two or three times the speed dropped to the point that the transition meter hand was in the red, but never long enough to do any damage. They reached Sanford about two a. m. Sparks had been on duty about twenty-eight hours with just a short nap. His eyelids felt as though each weighed a pound.

Leaving Sanford going towards Plainville, the track is slightly down grade the first twenty miles to Clear Creek, then there is thirty-two miles up hill, but the grade is not heavy. Sparks figured to sleep most of the way from Sanford to Plainville.

After drinking two cups of coffee and eating some, Sparks went to the rear cab of the Diesel and was sound asleep before the train pulled out. Five minutes after he went to sleep, so it seemed to Sparks, although it was nearer forty-five minutes, the fireman woke him up.

"What's the matter?" Sparks asked drowsily.

"Going to have to set out about a fourth of the train," the fireman told him. "There's something the matter with the No. 2 unit. It is not pulling."

"Where are we?" Sparks sat up with a jerk.

"Just crossed Clear Creek about five minutes ago," the fireman said. "Soon as we started up grade the train slowed down and I found the engine not pulling."

"Let's look at it," Sparks said as he slid from the seat.

The trouble was soon located. The rod from the power arm of the governor to the injector racks had broken in the threaded portion right back of a clevis. The indicator plate behind the governor showed the throttle was in the eighth position but the injector racks were in stop position.

"Tell the engineer to keep going," Sparks said to the fireman.

"We can't make it with three units," the fireman said.

"No, but we'll have four units when I get this one going." Sparks picked up the tool used for holding the injector racks and held them in start position and pushed the starter button. Then moving the racks by hand, he brought the engine up to speed. The train picked up speed immediately. All of the way to the top of the grade, Sparks throttled the engine by hand. By watching the hand on the indicator plate he could determine throttle position and move the injector racks accordingly. Already half dead from lack of sleep and almost too tired to stand, it was a nerve racking, man killing job, but he stuck to it and kept the unit working.

When the top of the grade was reached, Sparks let go of the lever and the engine died. He felt almost like doing the same. He staggered through the engine rooms to the cab, legs wobbly, arms aching, and the Diesel roaring in his head.

But he had won ten dollars off the boilermaker and incidentally made a successful run of the test trip.

Rewinding Traction Motors

(*Continued from page 405*)

machine. The tolerance to which the armatures are dynamically balanced affect the cost. The various balancing machines do not have indicators measuring in the same units such as ounce-inches or thousandths-of-inch amplitude. Table II gives limits of unbalance that have proved acceptable. The values in this table are in thousandths-of-an-inch amplitude as measured at the motor bearings. (Amplitude is the extent of the vibratory movement measured from one extreme to the opposite.) The values indicated are applicable when the armature is revolving at maximum rated speed in its own bearings.

Table II—Acceptable Limits of Unbalance

Maximum speed, r. p. m.	Amplitude unbalance at bearings		
	Fair	Good	Very Smooth
600	.004	.0025	.0013
900	.003	.0016	.001
1,200	.002	.0015	.0007
1,500	.0016	.001	.0006
1,800	.0013	.0008	.0005
2,400	.0009	.00051	.0003
3,000	.0006	.0004	.0002
3,600	.0005	.0003	.0002

Checks on the amplitude of unbalance may be made with a simple vibrometer of the type shown in Fig. 8,

which consists of a dial indicator mounted in a heavy base. The heavy base provides high inertia allowing the dial indicator case to remain substantially stationary in space while the indicator plunger is free to follow the linear motion of the bearing. Other types of simp portable indicators are available for these measurement

When double-deck bands are used, reduce the tensic values shown in Table I by 10 per cent for the top ban

CONSULTING DEPARTMENT

Steel or Wood Posts for Lights

What are the relative advantages of steel and wooden posts for supporting lights on platforms?

Climate and Availability May Govern Selection of Material

In deciding on the most suitable type of lighting post for a given platform, a coordination of the economic aspects and aesthetic requirements of the surroundings is necessary. The problem of supporting lighting fixtures on platforms is principally one of support and not one of strength to withstand unusual stresses.

Wood Posts

Wood posts of normal proportions usually have the required strength to support lighting fixtures used on platforms. They are relatively cheaper, lighter, easily fitted and erected. Wood posts of proper kind and structure, properly seasoned and treated against decay periodically with preservative compounds, especially at or near ground level, may last for thirty years or even longer. A concrete footing offers little added protection as compared with erection in soil, as rain and moisture traveling down through and around the wood cannot readily escape especially when shrinkage of the wood due to improper seasoning results in a separation from the concrete allowing the collection of large quantities of moisture. The useful life of a post depends to a large extent on the kind of wood used, nature of the ground, climatic conditions, the time and care taken in seasoning, and the kind of preservatives used and its method of application.

Decay is caused by vegetable organisms known as fungi. The latter require air and moisture at a suitable temperature in addition to food which is provided by the wood substance. A warm humid climate is conducive to decay. On the basis of heartwood resistance to decay, lightness and strength, posts are made of chestnut, cedar, southern cypress, and redwood. In the selection of posts, timber should be chosen that has been felled during the winter months; peeled, trimmed, and allowed to season for a period of at least twelve months; and then kept in a dry condition until painted or impregnated with a toxic preservative compound. Moisture is thus kept out, checking prevented, and the possibility of attack by fungi and insects greatly reduced. Where local conditions allow the use of preservative compounds in place of paint which would give the posts a more presentable appearance, creosote, zinc chloride, copper sulphate, and bichloride of mercury may be used. The application of preservatives by the brush or spray method is comparatively inexpensive but the results obtained are not as satisfactory as with the penetration method.

Steel Posts

Steel posts require a higher initial investment depending on the ornamental embellishments of the design. They are less vulnerable to damage by fires, and ma last for fifty years or longer, if regularly inspected ar painted when necessary. Dampness of the climate an impurities in the atmosphere of manufacturing and popu lous districts adversely affect the life span of steel post In such surroundings, reasonably longer life may only b expected from steel posts at higher maintenance cos This added expense may be to an extent as to make th use of wood posts of suitable design advisable. Whe steel posts are galvanized, the thin coating of zinc wi not protect the steel for more than a few years at t near the ground level unless the posts are embedded i a concrete casing extending about twelve inches abo ground level.

Concrete Posts

A practically everlasting structure may be built b reinforcing concrete with steel or iron rods if the archi tectural design of the posts will favorably blend with th rest of the platform design. While a concrete post wi generally cost higher initially, it requires no paintin and practically no maintenance once it is erected. I estimating the relative costs of the different kinds o posts, the possibility of using concrete posts should no be overlooked.

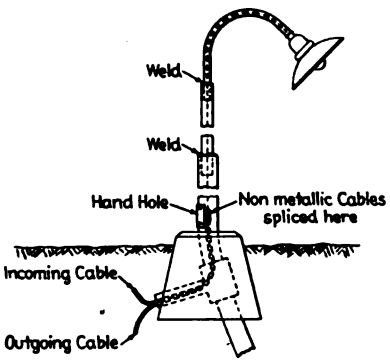
R. G. CAZANJIAN.

Metal Standards Have Inherent Advantages

By far the largest number of platform lighting stand ards in use are made from metal, but wooden posts hav been used in a great many instances. The obvious fea tures of long life and high strength are only two of th advantages obtained by the use of metal standards. Meta standards can and usually are made much more decora tive than wooden posts, and they have the advantage o being hollow, thus providing wire raceways. At th present time wooden posts have the advantage of bein less expensive and more easily obtainable than meta standards, and in many instances they are quite as satis factory. This is especially true when they are used a out-lying stations where the decorative effect is not quit so essential.

The safety precaution of proper grounding must b considered when installing any electrical equipment, an platform lighting standards are no exception to this rule Metal standards are usually placed in a concrete base which provides excellent support but at the same tim acts as a partial insulator between the metallic post an the ground. If the standard is connected to a metalli conduit system, it is automatically grounded, but if serv ice to the standard is by non-metallic underground cabl or by an overhead line, the standard should have addi tional grounding. One way of obtaining this is shown in the attached sketch, where a portion of the meta standard is shown to be extended below the concrete foundation and thus made to act as a ground rod.

The sketch shows a simplified type of platform lighting standard that can be made in any railroad's pipe shop. In normal times a variety of metal standards can be purchased on the market and come ready for immediate installation. However, in some instances it is convenient, though not always economical, to install a railroad made standard.



Proposed design for railroad-built platform lighting standard

Since ordinary wooden poles or posts do not provide a vertical raceway for wires, the service to wooden standards are usually run from post to post as open wires on secondary racks. This type of construction may be undesirable in some locations but it is economical of both labor and material, and thus should be considered whenever a platform lighting job is to be installed.

P. C. FREDKY.

Platforms or Vaults for Transformers

Why are apparently similar sets of transformers sometimes installed in vaults and sometimes on poles or pole platforms? What factors given the choice of installation?

Local Conditions Govern Choice

Prevailing conditions, rather than types of transformers, usually determine location of transformer installations. However, because of the fact that manufacturers often use the same type of cases for transformers having different characteristics, apparently identical transformers may be wound for differing voltages and purposes. Distribution transformers for lights and power are usually mounted on poles or pole racks depending on the size of the transformers used. Sometimes conditions are such that transformer installations for a plant or shop cannot be conveniently located outside because of lack of space or that overhead wires would interfere with operation of equipment such as cranes, derricks, etc. In such cases, installation of transformers in a vault eliminates the necessity for overhead wiring and poles.

Usually, first cost is less expensive when transformers are mounted on poles or pole racks instead of in vaults, but changing out transformers, renewing fuses, and general maintenance is simpler with vault installation.

If considerable current is used, line loss may be a deciding factor in determining transformer location, and it sometimes happens that in such instances pole mounting of transformers near enough to the center of distribution is not feasible.

Line voltages, both primary and secondary, have considerable bearing on how and where transformers will be located. Transformers used for reducing voltage from high voltage transmission lines to a lower voltage for distribution must of course usually be placed outdoors because of safety and impracticability of insulating, except by spacing for extremely high voltage. All of which adds up, as mentioned in the beginning, the manner and location of transformers are usually determined by existing conditions rather than by type of transformer.

W. L. COTTON.

Location of Load Center Is First Consideration

In order to understand why transformers are sometimes installed in vaults, and sometimes on poles, it is necessary to consider all of the factors involved in selecting a transformer location. Transformer locations can not, or at least should not be chosen by the "by guess and by gosh" method. It would be absurd for a railroad that passed through the center of a large city, to locate its only passenger and freight station in the suburbs. Likewise it would violate all rules of electrical design, to install a transformer bank in the suburbs of an electrical load. Therefore, the primary consideration in a problem of this type is the selection of a spot that is as near as possible to the load center. Very often it is impossible to locate transformers at the theoretically ideal place. When calculations are made the actual load center may be found to be in the center of the turn-table or in the middle of the waiting room. Obviously transformers can not be installed in such places, but the nearest practical spot to the theoretically preferred spot should be used.

If transformers are not installed at or near the load center, difficulties such as excessive voltage drop, and high line losses will be encountered.

When the engineer has selected the best available place to put his transformers, it then becomes an easy matter to decide whether to install them on a pole or in a vault. It would be undesirable to mount transformers on a pole, when the pole structure would be unsightly, and it would likewise be foolish to build a transformer vault in the middle of an open field. It is possible to conceive of some instances where either a pole or vault could be used. In these cases, other factors may influence the final decision. One of these factors might be the type of power line that is to be used in connection with the transformers. If an automatic-throw-over switch is to be used so that the transformer bank can be fed from either of two lines, then it may be desirable to provide the additional space and convenience offered by the vault. In some instances it may be found desirable to provide a transformer vault in order to protect the transformer's insulator bushings from the excessive smoke that is often found in the vicinity of engine houses.

Properly installed transformers should require very little service. However in out-of-the-way places, where only one electrician is on duty, the use of a vault will provide an extra safety factor. In the case of the vault installed transformers, it is unnecessary for an unaccompanied electrician to climb a pole that carries a faulty transformer.

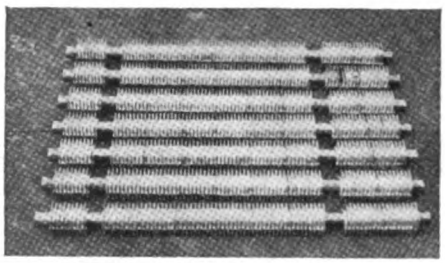
In the foregoing it has been assumed that the transformers in question are of average size, say 15 to 75 kva. Obviously very small transformers would be out of place in an especially built vault, and very large transformers should not be installed on poles.

P. C. FREDKY.

NEW DEVICES

General-Purpose Radiation Units

For some years past, Wilson Engineering Corporation, Chicago, has been furnishing iron directional radiation elements with integrally cast fins, for use in lo-



Radiating units made up of copper tubing and finned aluminum sections

comotive compressed-air systems, shop bake ovens, and for car-yard compressed-air radiation. This radiation element may be mounted in any position without pocketing of a static ambient air. In some adaptations, for instance, in Diesel-electric locomotives, the weight of cast iron has some disadvantages.

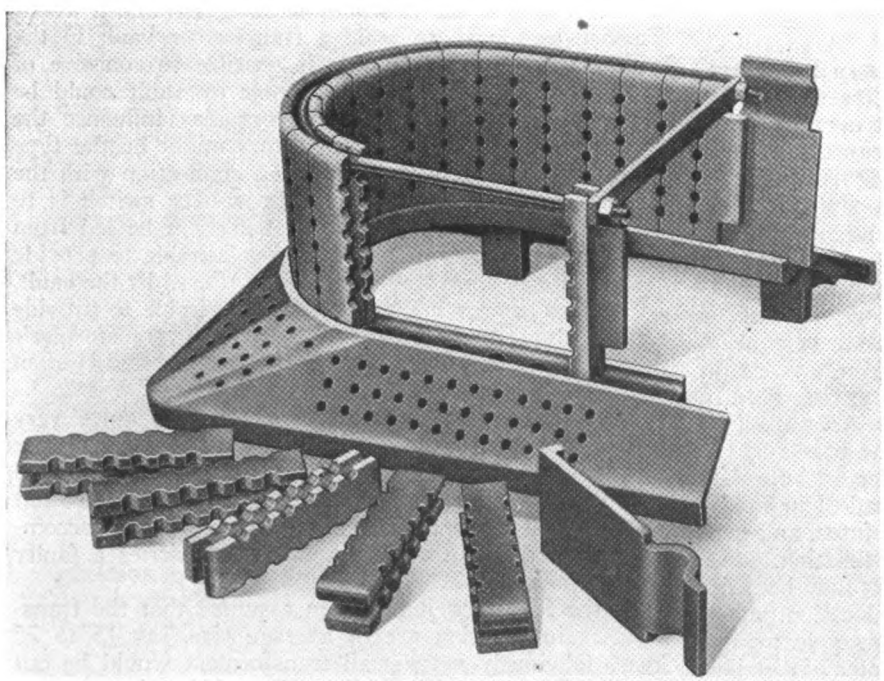
Copper and aluminum are now again available, and a new type, of radiation has been designed and developed by this company, to use these materials, in either high- or low-pressure service. The new radiation elements consist of suitable-strength copper tubing, combined with finned aluminum sections, to provide elements of any reasonable length. These radiation elements do not have the full advantage in vertical installation for radiation to static ambient air of the earlier types, but they are fully effective when installed horizontally. They also lend themselves to use in any position with blown air, as in Diesel-engine jacket cooling or compressed-air cooling.

The new radiation is adapted to the highest pressures required in locomotive practice and is lighter installed than earlier types of piped radiating units.

Sectional Stoker Grate

The Standard Stoker Company, Inc., New York 17, is now furnishing for use with Standard B and MB stokers, a sectional type grate in which only those portions deteriorating due to the heat in the firebox need be replaced when worn. The sectional grate consists of vertical sections which form the upper portion and are supported by shallow right and left base grates which, with few exceptions, can be applied to existing forked or double-center grate frames. The vertical sections are furnished in several lengths to suit the firing heights for different classes of locomotives. They fit into a U-shaped groove in the grate base and when assembled are locked in position by a U-shaped rod. All grate sections except the two at the ends are interchangeable for either the straight or curved sections of the grate.

Air openings in the vertical portions of the grate register with similar openings in the base grates and permit a flow of air to be drawn from the ash pan through the openings into the firebox. This air not only aids combustion, but helps materially and profitably to prolong the service life of the grates.



Breakdown view of parts comprising the sectional-type protecting grates for locomotive stokers

Lubrication and Bearing Refinements

As a result of laboratory research and improved manufacturing methods, the Magnus Metal Corporation, Chicago, has developed a number of refinements in the journal lubricator, journal bearings and motor support and armature bearings made by this company. The capacity of the oil

Magnus journal lubricator fabricated to increase the delivery of oil to the top of the cotton-wool pad

supply to the Magnus journal lubricator has been increased and made more uniform and continuous by improving the fabrication of the lubricating pads and wicking to deliver oil to the top of the cotton-wool pad which has a ¾-in. nap thus assuring a lower running temperature and longer bearing life.

New machinery and methods used in the manufacture of journal bearings include (1) an extremely accurate hardness testing machine which assures the rejection of any metal not fully or uniformly up to the requirements, (2) a new type machine for broaching bearing linings, including fillets, to a better, satin-smooth finish. Heat, friction and wear on bearing and journal are thus reduced. In addition, a new method of pressure application of lining metal is being developed which is designed to make a denser and more uniform lining, and assure a much stronger bond between the lining and back of the bearing.

New equipment has been added in order to supply completely finished bearings for motor support and armature bearings in addition to other similar applications.

The quality of journal bearings and locomotive castings is said to be stepped up by (1) improved methods of preparing and handling sand molds, (2) by the installation of new, more efficient sand

(Continued on next left-hand page)

OF PROGRESS

keeping wheels turning

Keeping wheels turning is the job of our railroads. It is a wartime job which is being done outstandingly well as current freight mileage figures keep right on testifying.

The job of chilled car wheel manufacturers is to keep the wheels *of progress* turning . . . to keep developing product improvements without interruption. Setting the industry's pace is the AMCCW, an organization which insists on integrity and demands a high degree of responsibility. Within its membership, leaders in the industry accept — as a condition of good Association standing, the uninterrupted maintenance of increasingly high standards of product quality.

Member companies offer more than lip service to achieve the goal of wheel improvement. As railroad service requirements have increased, new designs have been developed in anticipation of these requirements.

The thoroughness with which standards are upheld can be judged from the seven rigid tests which guarantee uniformity.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE, NEW YORK 17, N. Y. • 445 NORTH SACRAMENTO BOULEVARD, CHICAGO 12, ILL.

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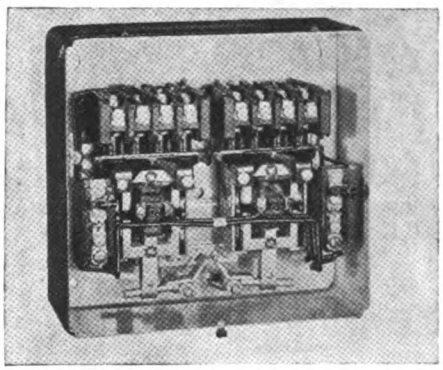
renovating equipment, and (3) by automatic heat control of the solder, babbit and Satco-metal kettles.

Motor Starter With Interlock

An a.c. magnetic reversing starter, featuring a semi-interference-type mechanical interlock, has been announced by the Industrial Control Division of the General Electric Company. Available is size 0 and 1,



The starter is furnished with either a hook-on or a dust-tight and water-tight enclosure

the starter is designed for full-voltage starting of squirrel-cage induction motors, and it can also be used for reversing service when combined with a reduced-voltage starter.

The semi-interference-type mechanical interlock prevents the closing of one contactor while an arc is maintained on the other, thus averting a short circuit through the arc and the resultant burned contacts and blown fuses. In addition, the interlock arm of the closing contactor assists the interlock arm of the opening contactor in reaching its fully opened position. These interlock arms are case-hardened and their underside faces are buffed and polished to assure long life.

Other features incorporated in this starter are under voltage protection when used with a push-button station or other momentary pilot-circuit device; under-voltage release when used with selector or limit switches; and tamper-proof, self-contained overload relays which allow the motor to operate up to its maximum safe temperature before tripping it off the line.

Quilted Insulation

A refrigerator car insulating material manufactured by the Charles Lachman Company, Inc., Phoenixville, Pa., is prepared from hair fibers, blended and combed into a batt form and sewed between layers of Sisalkraft paper. These insulating mats are not pressed, because the manufacturer's experience has shown that heat conductance is lowest when the hair batting is not compressed. This insulation, known by the trade name Equatemp, has a thermal conductivity of 0.24 to 0.26 B.t.u. per hour, per square foot, per deg. F., per 1-in. thickness. It is said to retain its form and efficiency throughout the car life, without shaking down or otherwise deteriorating.

Vapor Zone Control

The design of post-war passenger cars will unquestionably aim at providing maximum travel comfort for every passenger, and investigations conducted by the Vapor Car Heating Company, Inc., Chicago, indicate that this requires due consideration of the different zones in a car if passengers are to enjoy temperature comfort no matter where they sit in the car.

Temperature zoning takes into consideration the fact that the sunny side of a car may be 8 deg. F. higher in temperature than the shady side. In the heating season, separate thermostatic control on the sunny side of the car and the shady side make is possible for the car heating system to furnish only the exact amount of heat required and thus avoid over-heating or underheating due to the effect of the sun and the shade.

Another zone which affects temperature comfort is at the car end opposite the air-conditioning return grill where cool or cold air may be drawn into the car when the door is opened. This cold air, if drawn past passengers in the first seats of a coach, for example, results in considerable draft at that point; therefore, a separate thermostatic zone in this end of the car contributes greatly to passenger comfort.

The women's and men's lounging rooms, provided for comfort, are entirely separated from the body of the car and thus affected by temperature conditions different from those in the rest of the car. Plainly, the heating temperatures in these rooms must be controlled separately to insure full comfort.

In the past, it has been difficult and somewhat costly to provide the separate zones of heating, but with the Vapor heating system, designed for post-war cars, each additional zone inside the car will be heated by simply running a single radiating unit to the space being controlled and connecting it to a valve operated by a thermostat in that space.

The objective of this development is to supply zone heating which will keep all passengers comfortable regardless of the position which they may occupy in the car.

Journal-Box Packing Waste

The Miller Waste Mills, Inc., Winona, Minn., has developed a journal-box waste, known as Millerpax, which is designed to minimize waste grabs, waste wipes and rolling of packing and to assure the transmission of lubricant to car and locomotive journals under adverse conditions incident to modern high-speed operation.

Using special machinery of Miller design and construction, the new waste is made by three processes combined in one: The first operation removes any foreign matter, including grit, metal, wood, paper, etc., which the manual sorters may have missed; the second subjects the threads to an air-wash which thoroughly removes short ends and lint; the third definitely interweaves the threads into an almost endless mass which is best shown by the accompanying illustration. A new plant for the manufacture of this product is now under construction.

In connection with waste grabs, the interweaving of the new packing tends to prevent small segments of waste leaving the main body of the packing and getting between the bearing and the journal. Waste wipes are reduced by the air-wash process referred to, with removal of practically all free lint and short ends, as easily demonstrated by a comparative dry shake test, assuring uninterrupted flow of oil to all parts of the bearing. The rolling of packing is retarded by the interweaving process which effectively ties the entire mass of waste into one firm body and thus substantially reduces the usual shifting of packing.

This packing has been used by one of the principal rail carriers for the last year in passenger-car and locomotive service and other railroads have made service tests during the last six months. Equipment used in manufacturing the packing is so designed that any railroad specification can be met for all-wool packing, all-cotton packing, or any combination of the two. If resilient fibers are specified they can also be included.

The distribution of Millerpax is being handled by the Nash-Finch Company, Minneapolis, Minn., exclusive railroad sales representative for Miller Waste Mills, Inc.

Long interwoven fibers characterize Millerpax journal-box packing

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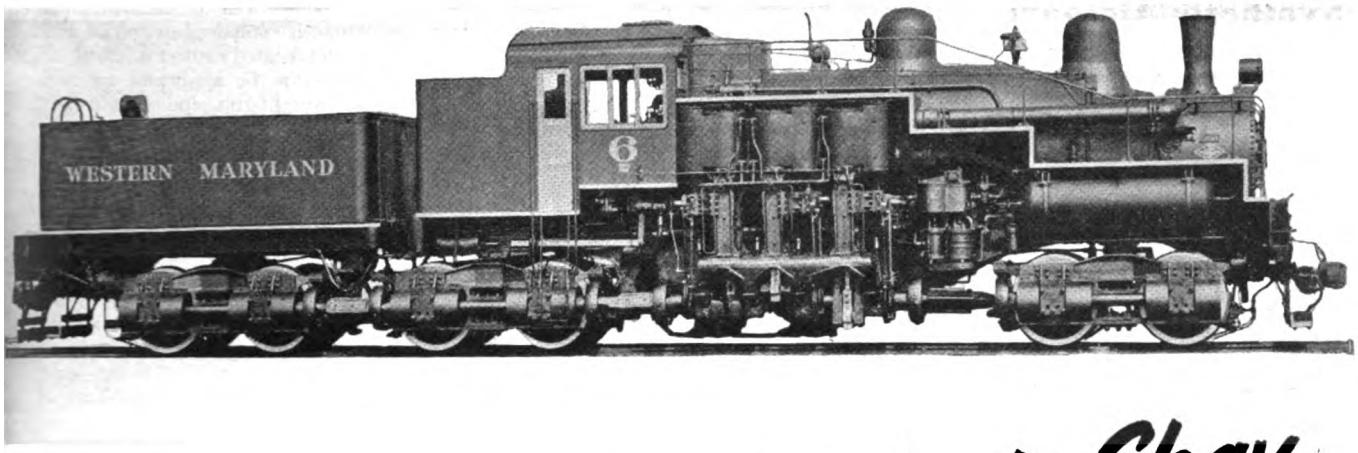


Western Maryland selects Shay

. . . for service on heavy grades

THE Western Maryland Railway has recently placed in service this new Class 150-3 truck Shay-geared locomotive for use on heavy grades and switchbacks in the mountains, supplementing other locomotives of the same type already in operation.

This coal-burning locomotive with a boiler pressure of 200 pounds develops a tractive effort of 59,740 pounds.

An important feature in its construction is that the piston valve cylinders are mounted independently of the boiler, being supported on heavy girder frames.

In addition to its ability to haul heavy loads up stiff grades — operating on some as steep as 10% — this Shay also holds loads on down grades because of its gear drive. It is designed to take any curve on which standard cars can be operated.

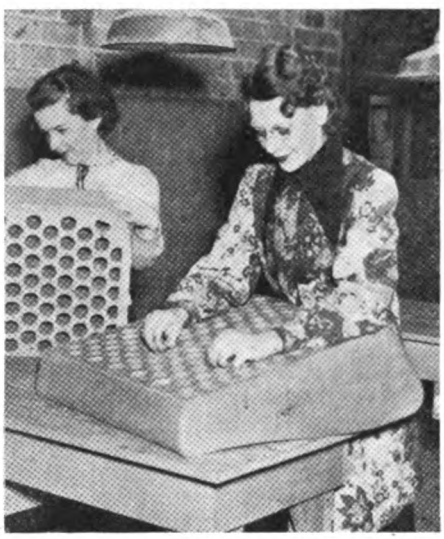
It is particularly efficient as a switching locomotive, due to the rapidity with which it can accelerate with a load and its ability to spot cars in minimum time.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

Synthetic Airfoam

The Goodyear Tire & Rubber Co., Akron, Ohio, has been successful in producing a synthetic rubber Airfoam. This material is said to be equal, and in some respects superior, to the pre-war natural rubber product, which was widely used and gave highly-satisfactory service, not only for passenger-car seat cushions and carpet padding, but for crew seats, arm rests, etc., in locomotives.

Among advantages claimed for the new synthetic-rubber Airfoam are greater flex life and aging characteristics and increased



Synthetic Airfoam seat cushions undergoing final inspection

resistance to oil. In one laboratory test of the new foamed latex, it was subjected 250,000 times at a rate of once per second to a pressure which compressed it to 50 per cent of its total thickness. At the end of the tests, the synthetic rubber Airfoam showed no loss in resilience. In another test, latex cushion material was subjected to an aging test for 30 days in a Geer oven at 158 deg. F., again with no appreciable change in the product. Still another test involved placing a section of synthetic rubber Airfoam in an "air bomb" at 260 deg. F. and at 60 lb. air pressure. Even under these conditions, the synthetic rubber product resisted any tendency to change shape or become hard, soft, or tacky.

Synthetic-rubber Airfoam is adaptable to the many sizes and shapes required for seat-cushioning purposes on different railroads, although standardization to some greater degree than at present would have a definite tendency to reduce manufacturing costs and the price to consumers. The fact that cushions can be produced in any thickness and shape desired eliminates the need for spring or other types of support between the foamed latex and the ventilated plywood or metal sheeting to which it is usually applied. The compression, or load-carrying capacity of the material can be varied by controlling the amount of air combined with the latex in mechanical whipping and thus secure any hardness desired within a fairly wide range.

Foamed latex cushions trend to dampen out any vibration transmitted through the car structure and, by making easy, automatic adjustment to every contour of a passenger's body, permit complete relaxation without sense of strain or fatigue even on long journeys. The material also contributes to comfort by carrying off heat and moisture in forced-air circulation through the cell-like structure.

Motor-Alternator For Passenger Cars

The Westinghouse Electric Corporation, Pittsburgh 30, Pa., has developed a motor-alternator designed for use on railroad passenger cars to convert direct current into alternating current for fluorescent lighting and other appliances operating from a.c. power such as electric razors, water coolers, and Precipitrons. It is an entirely self-contained unit arranged for mounting on the car underframing and has been designated as the Type XF-21 Motor Alternator.

The unit converts the nominal 64-volt, d.c. car power into 118-volt, 60-cycle, 3-phase a.c. power. When operating in this service its performance is said to be: Continuous rating, 4,200 volt-amperes with a d.c. supply voltage ranging from 55 to 90 volts; frequency regulation, approximately plus or minus one cycle from no load to full load at any constant d.c. supply voltage between 55 and 90 volts; approximately plus or minus two cycles over the full operating range from no load to full load with variation in the d.c. supply voltage from 55 to 90 volts; a.c. voltage regulation, allowable voltage variation is from 110 volts minimum to 125 volts maximum when operated from 55 to 90 volts d.c. supply and at any load up to full load; and nominal speed, 3,600 r.p.m.

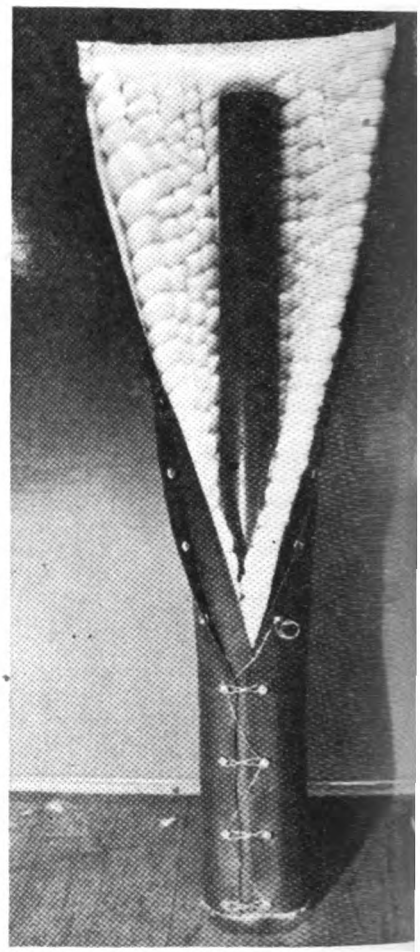
The construction of the motor-alternator includes those basic features which have been demonstrated to be essential for satisfactory operation in railroad service. The operating speed of 3,600 r.p.m. allows a considerable saving in weight, compared with a slower-speed unit. All rotating parts are balanced to insure smooth operation, freedom from vibration, and long life. Provision is made for flexible mounting. The brushes and brush-holders are arranged for ready access. The two ball bearings which carry the two armatures are oversized and arranged to gun-type lubrication.

The a.c. voltage and frequency-control apparatus furnishes rectified alternating current for varying the fields of the motor and generator. The control consists of three small transformers, three copper-oxide rectifiers, and three resistor tubes. A small Spencer-type thermostat disk, similar to those used in electric flat irons, is mounted in the motor-generator set and shorts a resistor when the set attains a near normal temperature to correct the speed and frequency for temperature change.

Pipe Insulation

An insulation designed particularly to meet the harsh service conditions encountered by steam train lines, on locomotive tenders and underneath passenger cars has been developed by the Gustin-Bacon Manufacturing Company of Kansas City, Mo. The product, announced as G-B Flexible Pip Insulation, is composed of special Fibergla fibers and coated asbestos cloth so con structed as to be applicable to curved a well as straight-run pipe on railroad equip ment.

The Fiberglas fibers are fabricated in a rope-like roving, spirally bound wit glass twine and fastened longitudinally t the asbestos jacket. This resilient Fibergl provides high, permanent thermal efficien and the rope construction permits easie more flexible application to pipes and sup plies a more uniform insulation at all point with a saving of approximately 20 pe cent in weight. Fiberglas, being impervio to deterioration from rot, moisture or hea



Fiberglas and asbestos are combined to mak this pipe covering

will maintain its efficiency under all operating conditions. It is designed to withstand the impact and abrasion of flying ballast. Under severe road service it will not sag or shake down.

The durable asbestos cloth jacket is waterproofed on the outer surface. Longitudinal sealing flaps with a 1-in. overlap at one end of each 3-ft. section assures a moisture-tight assembly. Strong nickel-plated hooks, securely fastened to the jacket, supply a quick application to the pipe by lacing with copper wire. The insulation is reclaimable and can easily be removed and re-applied. It is available for pipe or tubing ranging in diameter from ¾ in. to 4 in. and is regularly furnished in 3-ft. sections in a standard thickness of 1 in.

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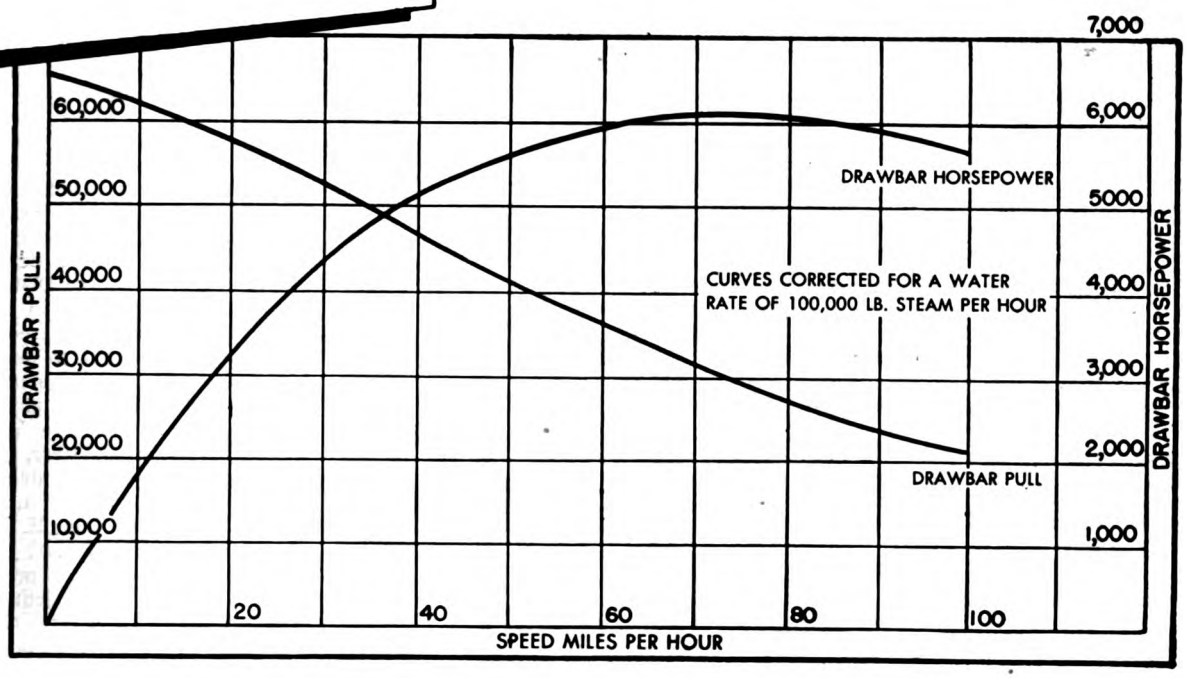
DRAWBAR HORSEPOWER

The Franklin System of Steam Distribution

applied to

The Pennsylvania Railroad's

T-1 Locomotives



"The T-1 locomotive developed a maximum of 6100 drawbar horsepower, which is 46 percent more than that of any other locomotive ever tested on the (Altoona) plant. * * *

"The T-1 locomotive was designed to haul a trailing load of 880 tons on level tangent track at a speed of 100 m.p.h. This requires a horsepower at the rear of the tender of 2980. If wind and engine and tender truck resistances are deducted from the drawbar pull shown in the graph, it is found that the T-1 locomotive develops 4100 horsepower at the rear of the tender at 100 m.p.h., which is about 38% greater than necessary to meet the requirements."

Quotation from paper by Ralph P. Johnson, Chief Engineer of the Baldwin Locomotive Works, read before the New York Railroad Club, May 17, 1945.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO

In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

NEWS

Welding Officers and Chairmen To Meet at New York, Oct. 18

THE American Welding Society will hold a meeting of the national officers, the board of directors, and committee chairmen in New York, at the Hotel Pennsylvania, on October 18, to deal with matters requiring official action. This group also will present the society prizes, medals and other awards which have been given at opening sessions for outstanding contributions in the advancement of the science and art of welding.

Although the annual meeting is not being held, the program committee of the society has arranged for the presentation of papers and discussions in the Welding Journal, the society's monthly magazine.

Diesel Operations Displace Coal

DIESEL-ELECTRIC locomotives produced 1944 service units which would have required "something in excess of 12.4 million tons of coal" if the equivalent service had been performed by coal-burning steam locomotives, according to calculations included by the Interstate Commerce Commission's Bureau of Transport Economics and Statistics in a recent issue of its "Monthly Comment on Transportation Statistics." Figures for this year's first four months indicate that the Diesels are off to a 1945 performance for the duplication of which coal burners would require "roughly 18 million tons" of coal.

Illinois Central Plans Lightweight Refrigerator Car

A LIGHTWEIGHT type of refrigerator car which, by the use of collapsible bulkheads, can be transformed into a box car in a matter of minutes, will be built and tested by the Illinois Central within a short time.

One of the special features of the new car is the fact that when completed it will weigh approximately 14,000 lb. less than the standard refrigerator car of today. It will be constructed of aluminum alloys for lightness and will be completely insulated with Fiberglas. It will be equipped with built-in fans for an effective cooling circulation of air from the floor through the ice-boxes to the ceiling, plus air-ducts for protective cooling of sidewalls and better distribution of air over and around the load. The fans also will assist in directing the air circulation when the car is in use with heaters to handle freight that requires protection against cold. There will be a double thermometer on the outside of the car that will show the inside temperature at top and bottom.

Collapsible ice-boxes, which will fold back as reinforcements for the ends of the car when used for other purposes will add approximately 6 ft. to the inside loading length of the car when in ordinary merchandise service. The total inside length at that time will be about 39 ft.

The car will be equipped with steel wheels and hollow axles. The trucks will be designed for smoothness in riding, using longer springs and built-in stabilizers in the truck bolsters. To prevent damage from horizontal shocks, the Duryea cushion underframe will be used.

The floor racks of the car will be of aluminum instead of wood for greater cleanliness, sanitation and non-retention of odors in handling foodstuffs. Synthetic rubber will be used in place of felt to seal the ice-loading hatches.

The car will be built in the Illinois Central shops at McComb, Ill., and is expected to be ready for testing about October 1. Construction will be based on plans perfected by the refrigerator car committee of the United Fresh Fruit & Vegetable Association. Collaborating in the arrangements for building and testing the car are the Aluminum Company of America and the Car Construction Committee of the Association of American Railroads.

A. S. M. E. Nominates Officers for 1945-46

D. ROBERT YARNALL, president of the Yarnall-Waring Company, Philadelphia, Pa., has been nominated by the National Nominating Committee of the American Society of Mechanical Engineers for the office of president of the Society for the year 1945-46.

Regional vice-presidents named by the committee to serve two-year terms on Council are A. R. Stevenson, Jr., staff assistant to the vice-president, General Electric Company, Schenectady, N. Y.; Samuel R. Beitler, professor hydraulic engineering, Ohio State University, Columbus, Ohio, and J. Calvin Brown, attorney at law and mechanical engineer, Los Angeles, Calif. Nominated regional vice-president for one-year terms are Rudolph F. Gagg, assistant to general manager, Wright Aeronautical Corporation, Paterson, N. J.; Edward E. Williams, general superintendent of steam plants, Duke Power Company, Charlotte, N. C., and Linn Helander, professor of mechanical engineering and head of the department of mechanical engineering, Kansas State College, Manhattan, Kans. Directors-at-large nominated to serve four-year terms on Council are Edgar J. Kates, consulting engineer, New York, and J. Noble Landis, assistant mechanical engineer, Consolidated Edison Company, New York.

To be continued in office for the remainder of their terms are Alton C. Chick, assistant vice-president and engineer, Manufacturers Mutual Fire Insurance Company, Providence, R. I., and Thomas S. McEwan, regional director, War Production Board, Seventh Federal Reserve District, Chicago. Messrs. Chick and McEwan have been redesignated regional vice-presidents. Also continuing on Council to serve two-year terms as directors-at-large are Daniel S. Ellis, vice-president in charge of manufacture, Lima Locomotive Works, Lima, Ohio, and Arthur J. Kerr, general sales manager, Pittsburgh Equitable Meter Company and Merco Nordstrom Valve Company, Tulsa, Okla. John E. Lovely, vice-president and chief engineer, Jones & Lamson Machine Company, Springfield, Vt.; David Larkin, vice-president and general manager, Broderick & Bascom Rope Company, St. Louis, Mo.; Samuel H. Graff, director of the Engineering Experiment Station, Oregon State College, Corvallis, Ore., and James M. Robert, dean, College of Engineering, Tulane University, New Orleans, La., continue on Council as directors-at-large for one-year terms.

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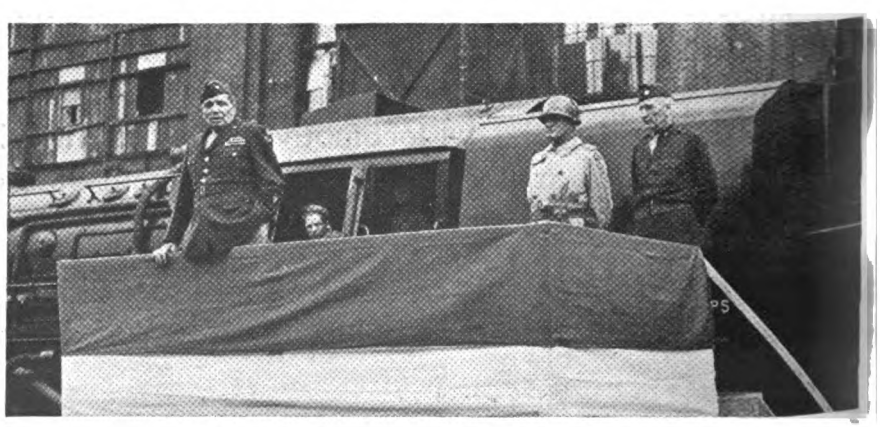


Army railroaders dedicate German locomotive to Gen. Gray

In recent ceremonies at Kassel, Germany, the first of 18 captured 2-10-0 German condenser-type locomotives was christened "Gen. Gray's Gull," for Brig. Gen. Carl R. Gray, Jr., director general of the Military Railway Service. The general is here shown addressing officers and enlisted men, while Col. William S. Carr, (in helmet) commanding officer of the 708th Railway Grand Division, and Lt. Col. John W. Moe, C.O. of the 757th Railway Operating Battalion, look on.

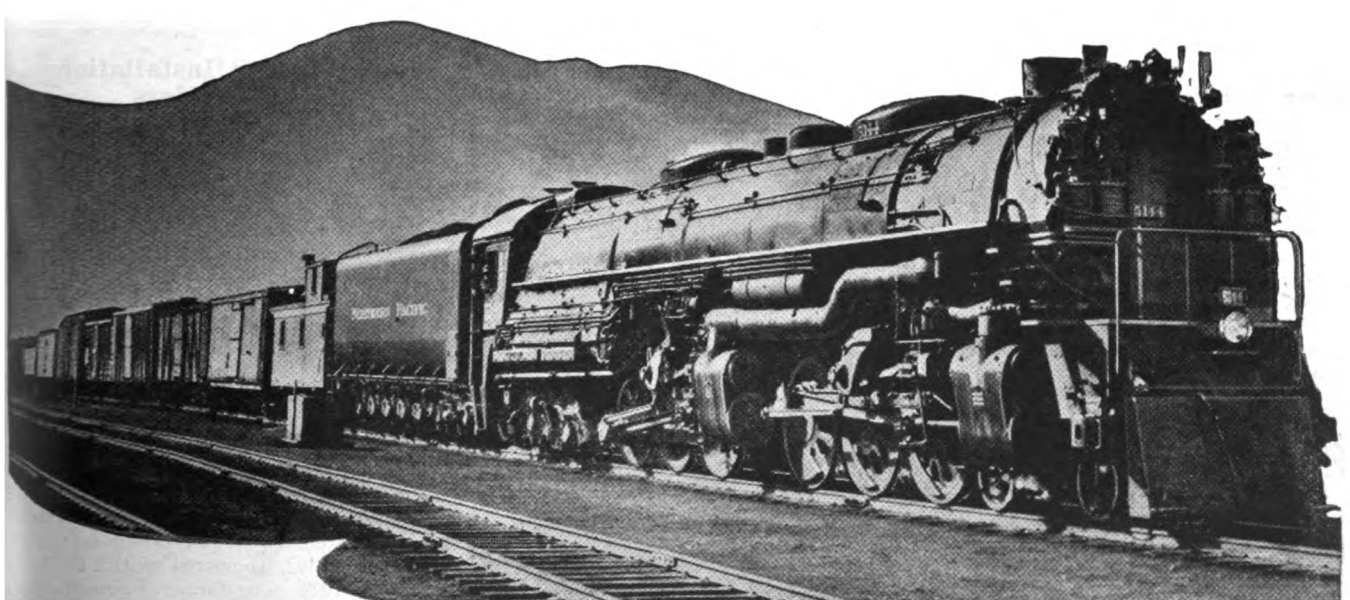
Availability IS HIGHER

with Security Circulators

To help maintain the high standard of performance of Northern Pacific's big 4-6-6-4s, each of them is equipped with eight Security Circulators.

Compared with other locomotives, those with Security Circulators are available for continuous operation for longer periods because they have cleaner flues, longer arch life, and improved combustion, so that boiler maintenance is substantially reduced.

These advantages are in addition to an improved circulation of water over the crown sheet and in side water-legs.



AMERICAN ARCH COMPANY, INC.

NEW YORK • CHICAGO

SECURITY CIRCULATOR DIVISION

Under a recent change in the Constitution of The American Society of Mechanical Engineers the Council is now organized to provide for eight regional vice-presidents to be elected for two-year terms and eight directors-at-large to be elected for four years. Each vice-president will be the leader in his region and will be the representative of that region on Council. He will be responsible for the successful functioning of the Sections and Branches in his area and for the administration of national programs that affect the regions. The directors-at-large will be chosen from among outstanding men in engineering regardless of residence.

Depreciation Rates G. M. O. Equipment

EQUIPMENT depreciation rates for the Gulf, Mobile & Ohio are among those prescribed by the Interstate Commerce Commission in a new series of sub-orders in the general proceeding, Depreciation Rates for Equipment of Steam Railroad Companies. The total ledger value of G. M. & O. equipment is given as $14,022,866, while the ledger value of leased equipment is $124,579.

The depreciation rates prescribed for G. M. & O. equipment (except streamlined passenger trains) which was formerly owned by the Gulf, Mobile & Northern are as follows: Steam locomotives, 4.12 per cent; freight-train cars, 3.64 per cent; passenger-train cars, 5.4 per cent; work equipment, 3.49 per cent. Rates on equipment formerly owned by the Mobile & Ohio are: Steam locomotives, 14.06 per cent; freight-train cars, 9.39 per cent; passenger-train cars, 11.23 per cent; work equipment 12.28 per cent; other rates on equipment owned are: Diesel-electric passenger locomotives, 6.58 per cent; Diesel-electric switching locomotives, 4.78 per cent; freight-train cars, 3.7 per cent; streamlined passenger trains, 6.53 per cent; work equipment, 6.41 per cent; miscellaneous equipment, 24.36 per cent. Rates on leased equipment are: Steam locomotives, 7.48 per cent; freight-train cars, 4.56 per cent; work equipment, 8.53 per cent.

Orders and Inquiries for New Equipment Placed Since the Closing of the August Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Virginian	5	2-8-4	Lima Locomotive Works

FREIGHT-CAR ORDERS

Road	No. of cars	Type of Car	Builder
Alton	40	8-wheel caboose	American Car & Fdry Co
Baltimore & Ohio	1,000	50-ton hopper	Bethlehem Steel Co.
	500	50-ton hopper	Ralston Steel Car Co.
	500	50-ton hopper	Pressed Steel Car Co.
Clinchfield	300	50-ton box	Mt. Vernon Car Mfg. Co
Detroit, Toledo & Ironton	200	70-ton covered hopper	Greenville Steel Car Co.
Louisville & Nashville	400	50-ton box	American Car & Fdry Co
	200	50-ton auto.	American Car & Fdry Co
	1,000	Hopper	Pullman-Standard
	400	50-ton box	Mt. Vernon Car Mfg. Co
St. Louis-Southwestern	250	50-ton box	Mt. Vernon Car Mfg. Co.
Pere Marquette	200	Automobile	Ralston Steel Car Co.
	100	70-ton covered hopper	Greenville Steel Car Co.
Western Maryland	40	70-ton cement hopper	American Car & Fdry Co

FREIGHT-CAR INQUIRIES

Baltimore & Ohio	350	70-ton cement
Canadian National	300	50-ton refrigerator
Chicago, Rock Island & Pacific	1,000	50-ton automobile
Denver & Rio Grande Western	200	70-ton ballast
	25	70-ton covered hopper
Chicago & North Western	800	70-ton gondola
Southern Pacific	1,600	50-ton box
	750	50-ton automobile
	200	50-ton gondola
	550	50-ton drop-bottom gondola
	250	70-ton hopper
	150	70-ton covered hopper
	50	Caboose

PASSENGER-CAR ORDERS

Road	No. of cars	Type of Car	Builder
Alton	15	Coaches	American Car & Fdry Co
Chesapeake & Ohio	2*	Streamline stainless-steel trains	Ed. G. Budd Mfg. Co.
Missouri Pacific	53	Streamline cars	American Car & Fdry Co

PASSENGER-CAR INQUIRIES

New York Central	...	Baggage and sleeping

* For service between Washington, D. C. and Cincinnati, Ohio. The trains will be powered by a new type of coal-burning steam-turbine electrically driven locomotive, three of which are now under construction.

Rock Island Has Roller-Bearing Box Car

On August 15 the Chicago, Rock Island & Pacific made a one-day display of its first Timken roller-bearing equipped, lightweight box car at the Union station in St. Louis, Mo. The car, which was designed by the Reynolds Metals Company and built by the Mt. Vernon Car Company, is constructed of the same alloy from which B-29 planes are made, and with the roller bearings and specially designed trucks, is capable of being operated at unusually high speeds. It was also said that the use of roller bearings on the axles makes possible a major reduction in starting resistance.

* * *

C. P. R. Photo

Canada's first aluminum-sheathed box car

Weighing 4,200 lb. less than a steel-sheathed car of similar capacity, the box car shown was built by the Canadian Pacific at its Angus shops, in Montreal. Sides, doors, roof, running board, brake steps and hand-brake housing are of aluminum. Two more such cars were built for the C. P. R. by the Canadian Car & Foundry Co., Ltd.

Equipment Installations and Orders

CLASS I railroads put 21,948 freight cars in service in the first six months this year according to the Association of American Railroads. In the same period last year 15,431 freight cars were installed. Those put in service in the first half of this year included 9,352 box, of which 8,765 were plain and 587 were automobile box cars; 3,561 gondola, 7,215 hopper, 380 flat, 1,13 refrigerator, 220 stock, and 87 miscellaneous cars.

Class I roads put 315 new locomotives in service in the first six months of 1945, of which 52 were steam and 263 were Diesel-electric. Locomotives installed in the same period last year totaled 494, including 19 steam, one electric, and 303 Diesel-electric.

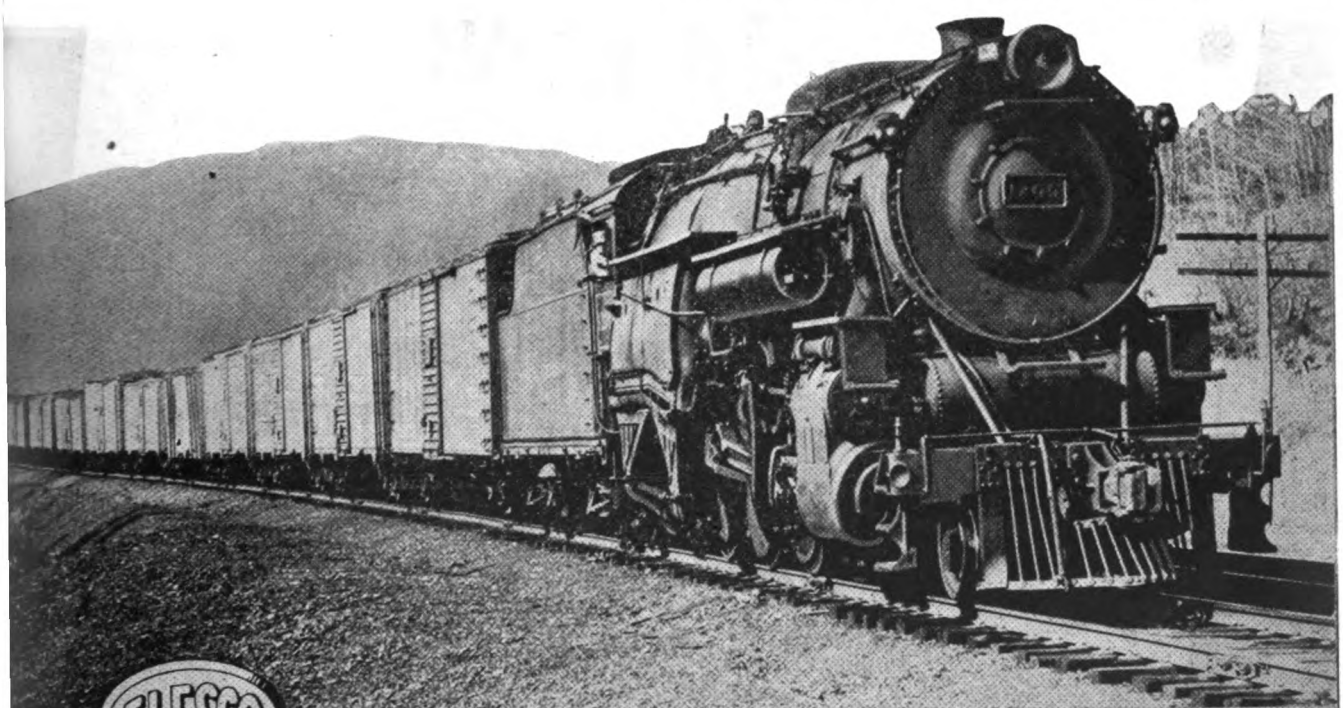
New freight cars on order on July 1 totaled 29,402, compared with 41,236 on July 1, 1944. The former figure included 18,914 box, of which 16,524 were plain box cars and 2,390 were automobile box cars; 4,425 gondola, 3,625 hopper, 932 flat, 1,437 refrigerator, 19 stock, and 50 miscellaneous freight cars.

Also on order on July 1 of this year were 508 locomotives compared with 581 on the same day in 1944. The 1945 total included 111 steam, two electric and 395 Diesel-electric, compared with 179 steam, two electric and 400 Diesel-electric one year ago.

(*Turn to second left-hand page*)

Something *Can* Be Done About It...

The boiler capacity of the older locomotives can be substantially increased by the application of Elesco exhaust steam injectors... the feedwater heater that provides the highest heat reclamation of any feedwater heater per unit of weight and cost.



ELESCO

SUPERHEATERS • FEEDWATER HEATERS
AMERICAN THROTTLES • STEAM DRYERS
EXHAUST STEAM INJECTORS • PYROMETERS

THE SUPERHEATER COMPANY

Representative of
AMERICAN THROTTLE COMPANY, INC.
60 East 42nd Street, NEW YORK
122 S. Michigan Blvd., CHICAGO

Montreal, Canada
THE SUPERHEATER COMPANY, LTD.

IT'S A GREAT NEW DAY FOR RAILROADING

It's doing as well— or better— right now!

GENERAL MOTORS
LOCOMOTIVES

IT'S A GREAT NEW DAY FOR RAILROADING

The Santa Fe operating
between Winslow, Ariz.
and San Bernardino, Cal.
goes through some mighty
mountainous terrain—
YET
A General Motors Diesel
freight locomotive
between April 1941,
and January 1945
operated 460,485 miles
with 85.7% average availability.
Average miles per month—
10,233.

ON TO FINAL VICTORY ★ BUY MORE WAR BONDS

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION • LA GRANGE, ILL.

Supply Trade Notes

SCHAEFER EQUIPMENT COMPANY.—*The Frank B. Nugent Company,* St. Paul, Minn., has been appointed representative in the northwest territory of the Schaefer Equipment Company, Pittsburgh, Pa.

◆

WEATHERHEAD COMPANY.—*J. F. Campbell* has been appointed chief development engineer, *Ralph Erskine* assistant development engineer, and *R. W. Phillips* laboratory director of the Weatherhead Company, Cleveland, Ohio. Mr. Campbell joined the Weatherhead Company earlier this year. He had previously been director and chief engineer of the Fuel Injection division of the Holley Carburetor Company, Detroit, Mich. Mr. Erskine has been a member of the company's development engineering staff and Mr. Phillips joined the engineering staff in 1941 and was appointed in charge of the hose division.

◆

ELECTRONIC LABORATORIES, INC.—*William W. Garstang,* vice-president and general manager, has been elected president of Electronic Laboratories, Inc., Indianapolis, Ind., to succeed *Norman R. Kevers* who becomes chairman of the board. *Walter E. Peek,* sales manager, *Paul H. Frye,* chief engineer, and *Harry C. May,* works production manager, have been appointed vice-presidents.

Electronic Laboratories, Inc., has announced four new manufacturer's representatives. *Harry B. Segar* will represent the company in Buffalo, N. Y.; *Arthur Rocke* in New York; *S. K. McDonald* in Philadelphia, Pa.; and *J. Y. Schoonmaker* in Dallas, Texas.

◆

A. M. BYERS COMPANY.—*Robert H. Gardner* has been appointed general manager of sales of the A. M. Byers Company to succeed the late Myron J. Czarniecki. Mr. Gardner has been manager of Byers' Washington office since 1933, except for a four-year period ended in 1940 during which he was manager of the company's steel pipe sales, with headquarters in Pittsburgh, Pa. Prior to joining Byers, he was assistant sales manager of the Caterpillar Tractor Company.

Robert H. Gardner

H. R. Rowland has been appointed assistant general manager of sales of the Byers Company. Mr. Rowland joined the company's sales department in 1915. He was appointed manager of the Pittsburgh division in 1925 and manager of hot rolled sales in 1944.

H. R. Rowland

◆

REYNOLDS METALS COMPANY.—*Barlow Brooks,* formerly manager of sales and development of Kinkaid Industries, Chicago, has resigned to become manager of the recently-created Finished Formed Shapes division of the Reynolds Metals Company, with headquarters at Louisville, Ky. The new division will supply a full line of continuous roll formed shapes and finished extrusions to manufacturers. Mr. Brooks was born at Oswego, N. Y., on September 21, 1906, and is a graduate of the State Trade School at Bridgeport, Conn., and of the University of Illinois. After graduation he went with the Standard Coupler Company and within five years became western sales representative, with headquarters at Chicago. In 1935 he joined the Kinkaid organization.

◆

WATSON-STILLMAN COMPANY.—*James S. Wilson* has been appointed manager of plastics equipment sales of the Watson-Stillman Company, Roselle, N. J. Mr. Wilson, who has been associated with Watson-Stillman for several years, was previously head of the plastics molding laboratory. Before that he was with the Plastics division of the General Electric Company.

◆

GALVIN MANUFACTURING CORPORATION.—*E. S. Goebel* has been appointed acting director of field sales in the communications and electronics division of the Galvin Manufacturing Corporation, in direct charge of all field salesmen. Norman Wunderlich has resigned as sales manager. *Daniel E. Noble* has been promoted to general manager of the communications and electronics division at Chicago. In his new position he will supervise the engineering, sales and engineering production departments of the division while retaining his present responsibilities as director of research.

◆

GENERAL STEEL CASTINGS CORPORATION.—*James Macdonald,* since 1939 assistant to the vice-president—sales of the General Steel Castings Corporation, has been appointed assistant to president. Mr. Macdonald was reported incorrectly as having been appointed assistant vice-president in the August issue of the *Railway Mechanical Engineer,* page 364. *Karl S. Howard* has been appointed assistant vice-president. Mr. Howard will continue as general mechanical superintendent. He will also assume the duties of general purchasing agent.

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*F. M. Gunn,* manager of the Pullman Car Works of the Pullman-Standard Car Manufacturing Co., has been appointed to assistant to the president, with headquarters as before at Chicago. *Harry B. Reed,* assistant manager of the plant, succeeds Mr. Gunn as manager. *Raymond M. Fox,* acting manager, has been appointed manager of works of the Butler, Pa., plant. Before his transfer to Butler, Mr. Fox was manager of works of Pullman-Standard's Hammond, Ind., plant for six years and as such directed its conversion from a freight-car shop to war work. He has been in the railway car-building business for 39 years. He joined Pullman-Standard in 1929 as an engineer in its Michigan City, Ind., plant; was transferred to the Hammond plant in 1937, and a year later was appointed manager of works there.

Raymond M. Fox

◆

DAMPNEY COMPANY OF AMERICA.—*John W. Laverack,* vice president and treasurer, has been appointed President of The Dampney Company of America, Hyde Park, Mass. Mr. Laverack succeeds *Clarence J. Hunter,* who becomes chairman of the board

technical director for special concen-ion on research and development and ension of the work of the Company in field of technical coatings for power and hanical operation equipment.

◆

TANDARD STOKER COMPANY.—*Christ T. ssen* has been appointed western sales nager and *John H. Ichter* eastern sales nager of the Standard Stoker Company, headquarters at Chicago and New k respectively.

◆

ATIONAL MALLEABLE & STEEL CAST-S COMPANY.—*Ray E. Valentine* has appointed St. Louis, Mo., office sales nt for the National Malleable & Steel tings Company. Mr. Valentine has

Ray E. Valentine

n associated with National Malleable ce 1912. After serving in the traffic partment, he joined the sales division in eveland, Ohio, in 1914. He was assigned the St. Louis sales office in 1927 and a ar later transferred to the Chicago plant, ere he remained for sixteen years. He a graduate of Baldwin-Wallace Law hool (1891) and was contracting freight ent of the Wheeling & Lake Erie from 10 to 1912. Mr. Valentine has been with War Production Board in Washington ce 1943 as chief of the malleable-iron tion.

◆

LEHON COMPANY.—*David M. Water-use* has been appointed eastern repre-ntative of The Lehon Co., Chicago, to ndle sales for railroads, car builders, ctric lines and others connected with transportation industry. Mr. Water-use will maintain headquarters at 50 urch street, New York.

◆

WESTINGHOUSE ELECTRIC CORPORATION.—*alph R. Brady,* for the past three years anager of commercial engineering for the mp division of the Westinghouse Elec-ic Corporation, has been appointed man-ger of electric discharge lamp sales.

◆

MONROE AUTO EQUIPMENT COMPANY.—*. J. Smith,* formerly with the Packard lotor Car Company, has been appointed hief engineer of the Monroe Auto Equip-ent Company with headquarters at Monroe, Mich. Mr. Smith entered the employ of the Packard organization several years ago and at the beginning of World War II was placed in charge of the experimental engineering program at the tank arsenal proving grounds. In his position with Monroe he will direct the company's widely expanded program which now covers practically every branch of the transportation field and includes products for railroad passenger and freight cars, automobiles, trucks, busses, tractors and various types of war equipment such as tanks, airplanes and heavy transportation equipment.

◆

PEERLESS EQUIPMENT COMPANY.—*Walter H. Radeke,* formerly service manager of the Gould Storage Battery Co., Depew, N. Y., has joined the Peerless Equipment Co., as service engineer, with headquarters at Chicago, servicing Gould storage batteries in railway service.

◆

JOSHUA HENDY IRON WORKS.—*James L. Ray* has been appointed head of the gas and steam turbine engineering department in San Francisco, Calif., of the Joshua Hendy Iron Works, Sunnyvale, Calf. Mr. Ray formerly was chief gas-turbine design engineer of the Allis-Chalmers Manufacturing Company.

◆

AMERICAN LOCOMOTIVE COMPANY.—*John T. Tarpey,* western representative of the Pittsburgh Spring & Steel Co., has been appointed to the sales staff of the Chicago office of the American Locomotive Company. Mr. Tarpey joined the Chicago office of Pittsburgh Spring & Steel in 1916. After military service during the last war, he returned to the company in 1919 and was appointed western representative in 1934.

◆

FRANK B. NUGENT COMPANY.—*Frank B. Nugent,* who has represented the Barco Manufacturing Company, Not Inc., in the northwest territory for the past 22 years, has organized his own company, the Frank B. Nugent Company, with offices in St. Paul, Minn. He will continue to represent Barco, as well as several other manufacturers of railway equipment.

◆

FIRTH-STERLING STEEL COMPANY.—*Lloyd R. Clowes,* Pittsburgh district sales manager of the Firth-Sterling Steel Company, has been appointed assistant general sales manager of the company.

◆

AMERICAN CAR AND FOUNDRY COMPANY.—*E. A. Lofquist,* a graduate of the U. S. Naval Academy and until recently on active duty as a Captain in the U. S. Navy, has been appointed a special representative for the sales department of the American Car and Foundry Company. Mr. Lofquist will have his headquarters at Chicago.

◆

BUCKEYE STEEL CASTINGS COMPANY.—*George T. Johnson* has been elected president and general manager of the Buckeye Steel Castings Company to succeed *A. H. Thomas,* who becomes chairman of the board. Mr. Johnson is a graduate of Cornell University with a degree in mechanical engineering. He joined the Buckeye Steel Castings Company as a moulder's helper in the foundry and progressed through the various departments until he was appointed in charge of the engineering and inspection divisions. Later he was appointed successively third vice-president and second vice-president in charge of production and sales engineering. He was elected first vice-president in charge of the sales department in 1937, with other administrative duties including general supervision of engineering. Mr. Johnson is a member of the American Society of Mechanical Engineers, the American Society of Testing Materials, and has served on various committees touching on the activities of the cast steel and railroad equipment industries.

◆

KENNAMETAL, INC.—*W. D. Turnbull* has been appointed general sales manager of Kennametal, Inc., Latrobe, Pa.

◆

LEHON COMPANY.—*David M. Waterhouse* has been appointed eastern representative of the Lehon Company, Chicago. Mr. Waterhouse will maintain headquarters at 50 Church street, New York.

◆

WORTHINGTON PUMP AND MACHINERY CORPORATION.—*Harry A. Feldbush,* formerly works manager of the Holyoke, Mass., plant of the Worthington Pump and

H. A. Feldbush

Machinery Corporation, has been appointed vice-president in charge of engineering activities of all works and domestic subsidiary companies of the Worthington Pump & Machinery Corporation. His headquarters will be at the general offices in Harrison, N. J.

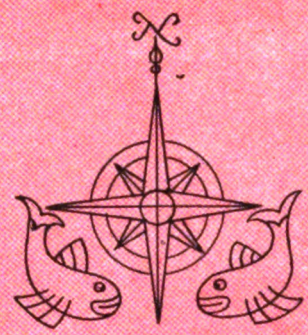
◆

REPUBLIC STEEL CORPORATION.—N. J. *Clarke* and *J. M. Schlemdorf* have been elected senior vice-president and vice-president in charge of sales, respectively, of the Republic Steel Corp.

◆

LOCOMOTIVE FINISHED MATERIAL COMPANY.—The *Frank B. Nugent Company,* St. Paul, Minn., has been appointed a representative of The Locomotive Finished Material Company, Atchison, Kan.

(*Turn to second left-hand page*)



You can find ALCO Locomotives in any part of the Globe

ALCO recently delivered six narrow-gauge, mountain-type steam locomotives to the Paraná Santa Catarina Railroad of Brazil. This road is a vital link between the rail systems of the south and the roads serving the industrial center of São Paulo—sometimes called the "Chicago of Brazil."

The chief freight of the line is coal, and hauling it to the great industries in São Paulo is an important part of the Brazilian National Defense Program.

ALCO locomotives are in every type of service, and serving in all parts of the world. Whether they are steam, Alco-G. E., diesel-electric, or straight electric; whether they burn oil, coal or wood—the important thing about ALCO locomotives is their economy of performance.

They're *right* for the job because they are built for the job.

American Locomotive

THE MARK OF MODERN LOCOMOTION

Paraná Santa Catarina's Alco-built 4-8-2 type locomotives burn wood. Although the chief freight of the line is coal, the conservation of coal deposits is imperative. And the abundance of wood in the region makes wood the logical and economical fuel for locomotive use.

DAYTON RUBBER MANUFACTURING COMPANY.—*John A. MacMillan* has retired as chairman of the board of the Dayton Rubber Manufacturing Company. During the past 35 years, Mr. MacMillan, a co-founder of Dayton Rubber, has served as general manager, president and chairman of the board. He will continue as a director.

◆

ARO EQUIPMENT CORPORATION.—The Aro Equipment Corporation, Bryan, Ohio, has appointed the following four new jobbers to handle its line of industrial pneumatic tools under the supervision of the local division managers in the respective territories: *C. S. Kegerreis Supply, Inc.*, Elkhart, Ind., under the supervision of Clark & Osborne; the *Western Iron Stores Company*, Milwaukee, Wis., under Charles D. Haven, Jr.; the *General Supply Company*, Kansas City, Mo., under W. L. Etherton; and *Overton and Ross, Inc.*, Wichita Falls, Tex., under W. F. Vogel.

◆

CLEVELAND PNEUMATIC TOOL COMPANY.—The Cleveland Pneumatic Tool Company, Cleveland, Ohio, has announced the formation of a railway division with eastern headquarters at 50 Church street, New York. *John N. Thorp* has been appointed special representative of the division.

◆

HOMESTEAD VALVE MANUFACTURING COMPANY.—*Don H. Krey* has been appointed sales manager, and *Elliott G. Johnson* assistant sales manager of the Homestead Valve Manufacturing Company, Coraopolis, Pa. Mr. Krey will direct all phases of the company's sales efforts including valves, Hypressure Jenny steam cleaners, and Hypressure Jenny compound sales and research; while Mr. Johnson will supervise all valve-sales activities in addition to retaining his duties as director of advertising and public relations.

OKONITE COMPANY.—*E. J. Garrigan*, formerly vice-president and factory sales manager, has been appointed vice-president in charge of sales of the Okonite Company and its Hazard Insulated Wire Works division and its affiliate, the Okonite-Callender Cable Co. Mr. Garrigan who is a director of the company, will continue at the executive offices in Passaic, N. J. He joined the Okonite organization in 1924. *C. E. Brown, Jr.*, formerly vice-president in charge of the company's Washington, D. C., office, has been appointed vice-president and general sales manager to coordinate the activities of the executive offices in Passaic with the company's branch offices. Mr. Brown, who will have offices at Passaic as well as in the New York district sales office, has been with the Okonite sales organization since 1919, first as an agent with the Central Electric Company of Chicago, and later, in 1925, as manager of Okonite's power and light department in the Chicago territory. He will also take over the duties performed by the late W. K. Vanderpoel in acting as a contact executive between the officials of the power and light utilities and Okonite's utility specialists in branch offices.

Obituary

L. E. ELLIOTT, service engineer of the National Aluminate Corp., Chicago, with headquarters at Lexington, Ky., died at the home of a daughter in Excelsior, Minn., on July 20.

◆

WILLIAM H. BRYANT, general sales manager of Joseph T. Ryerson & Son, Inc., with headquarters at Chicago, died at his summer home in Iron Mountain, Mich., on July 23.

HAROLD MCCREADY, district manager, New York office, of the Union Switch & Signal Co., died August 1. Mr. McCready was 60 years of age. He was a graduate, with a degree in electrical engineering of the Massachusetts Institute of Technology in 1908. He was employed as a signal helper on the Pennsylvania Lines West, during the summers of 1902 and 1903. He joined the Union Switch & Signal Co. in 1904

Harold McCready

as circuit draftsman and worked on the construction of the New York subway until the summer of 1905. He became signal foreman on the West Jersey & Seashore electrification in 1907. He was appointed assistant engineer of Union Switch & Signal in 1908 and engineer-in-charge, electrical department, in 1912. He was transferred to the sales department in 1914 as New York office manager and became assistant eastern manager in 1923 and district manager of the New York office in January, 1937.

Personal Mention

General

L. C. KIRKHUFF, master mechanic of the New River division of the Virginian at Elmore, W. Va., has been appointed assistant superintendent of motive power, at Princeton, W. Va.

SHERMAN O. RENTSCHLER, whose appointment as superintendent of motive power at the Elgin, Joliet & Eastern, with headquarters at Joliet, Ill., was reported in July issue, was born at Verdon, Neb., on October 12, 1904, and is a graduate of the University of Nebraska. He entered railway service as a special apprentice in the employ of the Missouri Pacific in September, 1923, subsequently serving as a machinist, division foreman, enginehouse foreman and general passenger-shop foreman at various points on the road, including St. Joseph, Mo., Omaha, Neb., and Lincoln; Wichita, Kan., Hoisington and Ossawatomie, and Kansas City, Mo. After serving as general shop foreman at Sedalia, Mo., Mr. Rentschler in August, 1942, became shop superintendent, at Sedalia. On October 1, 1943, he was appointed mechanical superintendent of the Southern district,

Sherman O. Rentschler

with headquarters at St. Louis, and in November, 1944, became assistant chief mechanical officer. He resigned on April 1, 1945, to become superintendent of motive power of the E. J. & E.

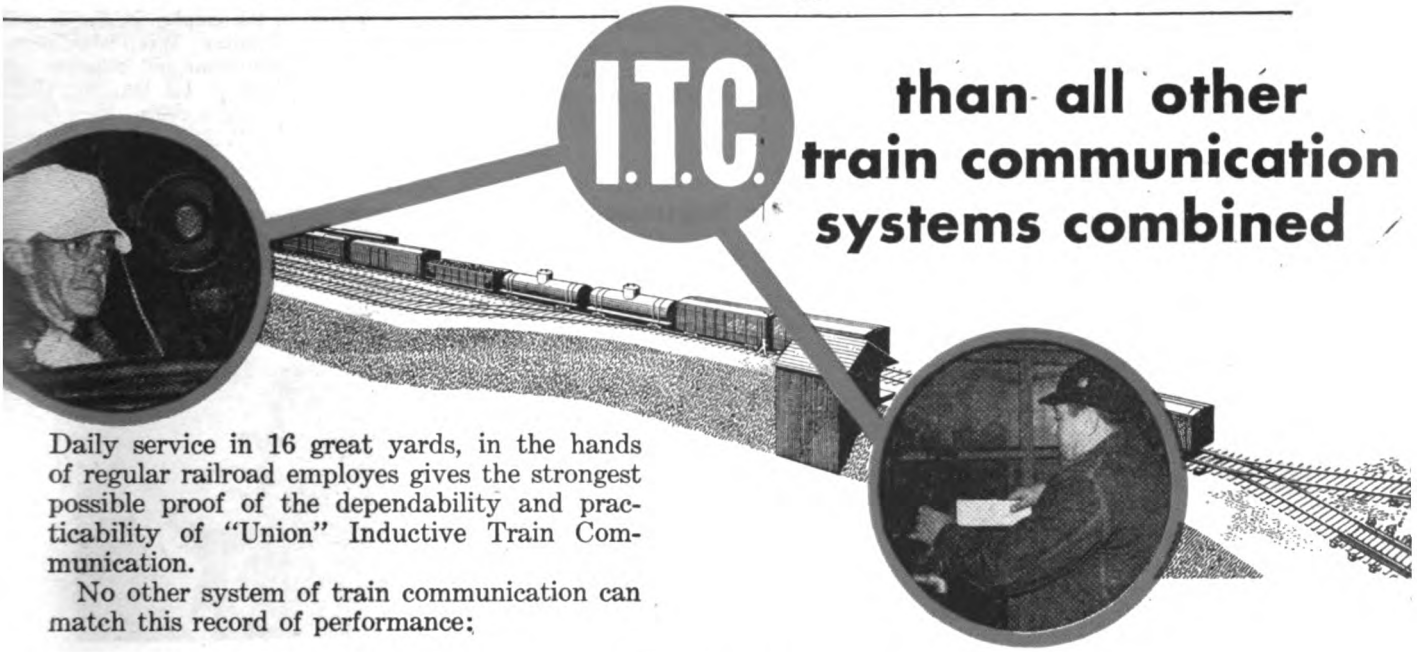
D. J. COON, mechanical supervisor of the New York, Chicago & St. Louis, has been appointed fuel supervisor with headquarters as before at Cleveland, Ohio.

W. R. HARRISON, who has been on leave of absence from the Atchison, Topeka & Santa Fe, has returned to the position of mechanical superintendent of the Southern district, with headquarters at Amarillo, Tex.

A. G. KANN, whose promotion to general superintendent of equipment of the Illinois Central at Chicago, was noted in the July issue, was born on August 23, 1894. He entered the service of the I. C. on November 14, 1911, as an apprentice machinist at

(Continued on next left-hand page)

MORE YARDS are using "UNION"



Daily service in 16 great yards, in the hands of regular railroad employes gives the strongest possible proof of the dependability and practicability of "Union" Inductive Train Communication.

No other system of train communication can match this record of performance:

Cleveland, Cincinnati, Chicago & St. Louis Ry.

Sharonville, Ohio. One-way equipment for two locomotives and one office, utilizing one frequency, at the hump classification yard.

Chicago, Burlington & Quincy R.R. Co.

Galesburg, Ill. Eastbound and westbound hump classification yards equipped for one-way communication using two frequencies to separate communications between the two yards. Equipment is installed on 10 locomotives and in the hump conductors' offices at both humps.

Lincoln, Neb. One-way, one-frequency equipment installed on three locomotives and in the hump conductor's office at the hump classification yard.

Great Northern Ry. Co.

Allouez, Wis. One-way equipment, utilizing one frequency installed on two locomotives and in one office at the hump yard.

Louisville & Nashville R.R. Co.

DeCoursey, Ky. Equipment for one-way communication, utilizing one frequency installed on three locomotives and in one office at the hump yard.

Norfolk & Western Ry. Co.

Roanoke, Va. Two-way, one-frequency equipment installed on three locomotives and in one office at the hump yard.

The Pennsylvania R.R.

Altoona, Pa. One-way equipment installed on three locomotives operating in two hump yards. Two offices are also equipped. Two frequencies are employed to separate communications in one yard from those of the other.

Columbus, Ohio. One-way, one-frequency equipment installed on three locomotives and one office at the hump yard.

Harrisburg, Pa. (Enola Yards). One-way equipment installed on nine locomotives operating in two hump yards. Two offices are also equipped. Two frequencies are employed, to prevent interference between the two yards.

Indianapolis, Ind. (Hawthorne Yard). One-way, one-frequency equipment installed on three locomotives and in one office at the hump yard.

Pitcairn, Pa. One-way, one-frequency equipment installed on eight locomotives and in one office at the hump yard.

Pittsburgh, Pa. (Strip District). Two-way equipment, utilizing one frequency installed on two locomotives and three offices in an industrial switching district.

Terminal R.R. Association of St. Louis

East St. Louis, Ill. One-way, one-frequency equipment installed on one locomotive and in one office at the hump yard.

"Union" I.T.C. was developed for railroad use by men who know railroad needs, and has been proved through years of regular railroad service.

UNION SWITCH & SIGNAL COMPANY

SWISSVALE PENNSYLVANIA

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO

Waterloo, Iowa, subsequently serving as a machinist, assistant night enginehouse foreman, air-brake foreman, and gang foreman. On November 16, 1929, he was promoted

A. G. Kann

to the position of general foreman, with headquarters at Council Bluffs, Iowa; in 1931 was transferred to Waterloo; on September 1, 1938, was appointed master mechanic, with headquarters at Champaign, Ill.; in 1939 transferred to Waterloo, and on July 16, 1940, appointed master mechanic at Waterloo.

P. J. DANNEBERG, who has been acting mechanical superintendent of the Santa Fe at Amarillo, Tex., has returned to his former position of mechanical superintendent of the Northern district, with headquarters at La Junta, Colo.

Master Mechanics and Road Foremen

E. A. MCCRAW, engineer of the Union Pacific at North Platte, Neb., has been promoted to the position of road foreman of engines, with headquarters at North Platte.

T. R. BRITT, traveling fireman of the Union Pacific at North Platte, Neb., has been appointed road foreman of engines, with headquarters at Council Bluffs, Iowa.

E. P. LEE, road foreman of engines of the Union Pacific at Council Bluffs, Iowa, has been appointed road foreman of passenger engines, with headquarters at Council Bluffs.

W. W. LYONS, who has been serving as acting mechanical superintendent of the Northern district of the Santa Fe at La Junta, Colo., has returned to the position of master mechanic at Dodge City, Iowa.

C. G. FOSTER, general foreman of the Virginian at Sewalls Point, Va., has been appointed master mechanic of the Norfolk division, with headquarters at Victoria.

R. G. BENNETT, JR., master mechanic of the Virginian's Norfolk division at Victoria, Va., has been transferred to the position of master mechanic of the New River division, with headquarters at Elmore, W. Va.

D. R. BURGHARDT, fireman of the Union Pacific at Council Bluffs, Iowa, has been promoted to the position of traveling fireman, with headquarters at Council Bluffs, Iowa.

Car Department

C. P. NELSON, assistant superintendent of car shops of the Chicago & North Western at Chicago, has been appointed superintendent of the car department, with headquarters at Chicago.

J. L. TYRE, traveling car inspector of the Atlantic Coast Line, has been appointed general car inspector of the Southern division with headquarters at Waycross, Ga.

G. R. ANDERSEN, assistant superintendent of the car department of the Chicago & North Western at Chicago, has been appointed to superintendent of the car department. Mr. Andersen was born at Kankakee, Ill., on September 27, 1889, and is a graduate of DePaul University. He entered railway service on May 3, 1911, as a car inspector in the employ of the North Western at Milwaukee, Wis., later serving as chief car inspector and assistant car foreman at Milwaukee. On March 1, 1920, he became general car foreman, with headquarters at Butler, Wis., and one year later assistant master car builder at Chicago.

George R. Andersen

In 1925, Mr. Andersen was appointed master car builder at Chicago, and on April 1, 1942, assistant superintendent of the car department.

J. H. WELCH, traveling car inspector of the Atlantic Coast Line, has been appointed general car inspector of the Northern division.

In Military Service

LEGION OF MERIT AWARD

COL. AUBREY M. BRUCE, of Alton, Ill., on leave from the Illinois Terminal Railroad at St. Louis, has been awarded the Legion of Merit for "exceptionally meritorious conduct in the performance of outstanding service" (from February 9, 1943, to May 17, 1945) as superintendent of equipment for the Third Military Railway Service in the Persian Gulf Command, Headquarters now reports. Colonel Bruce received his award from Brig. Gen. Donald P. Booth, commanding the P. G. C., at special ceremonies in Teheran, Iran. "As superintendent of equipment when the Third Military Railway Service assumed operation of the Iranian State Railway," the citation said, in part, "Colonel Bruce demonstrated a high degree of leadership and ability in coordinating and supervising the maintenance and repair of the railway equipment." A veteran of World War I, and a reserve officer when called to active duty in October, 1942, Colonel Bruce was head of the 3rd M. R. S. for two months prior to its dissolution on July 1. In civilian life he was master mechanic of the Illinois Terminal at Alton.

BRONZE STAR MEDAL

Col. Fay L. King, head of the 2nd M. R. S. equipment section. Colonel King, who was district master mechanic for the Chicago, Milwaukee, St. Paul & Pacific before entering the service, won his citation for "services in connection with special installations in L. S. T.'s for ferrying railway equipment from England to France, and for his supervision and planning of repair shops and enginehouses at Cherbourg."

Shop and Enginehouse

P. J. LANE has been appointed general locomotive foreman of the Union Pacific at Omaha, Neb. This is the second such position at Omaha, the first being held by F. J. Stehno, who was appointed in January, 1942. Mr. Lane was formerly foreman of a gang stripping and rebuilding locomotives at Omaha.

BLAIR L. THOMPSON, mechanical inspector of the Canadian National at Montreal, Que., has been appointed night superintendent, Point St. Charles motive power shop at Montreal.

THOMAS BOONE, night superintendent at the Point St. Charles motive-power shop of the Canadian National at Montreal, Que., has retired after nearly 37 years' service.

D. J. EVERETT, who has been serving as acting master mechanic of the Southern at Dodge City, Iowa, has returned to the position of general mechanical inspector at Topeka, Kans.

Obituary

THOMAS M. CONNIFF, superintendent of shops of the Delaware, Lackawanna & Western, at Scranton, Pa., died in a hospital at that city on August 10.

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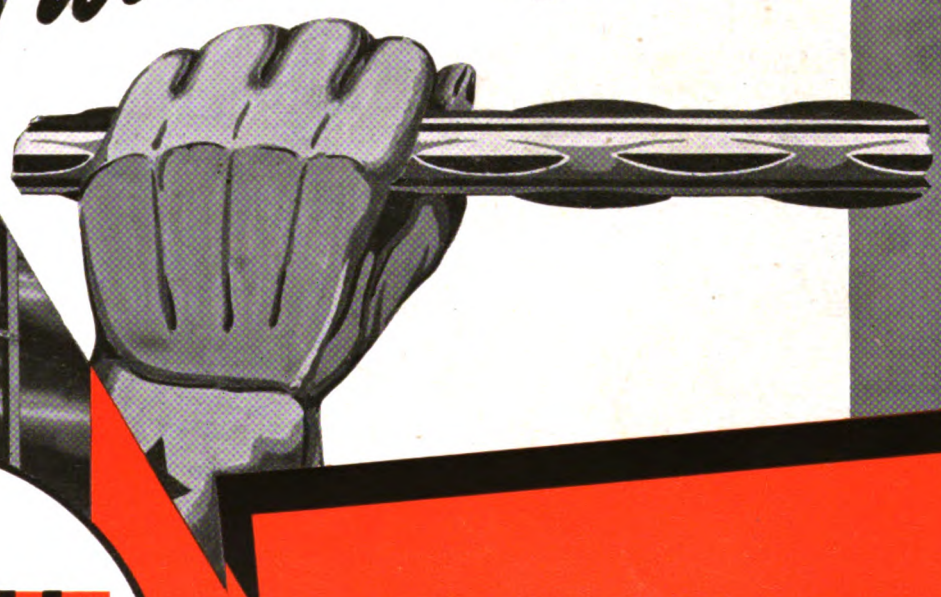

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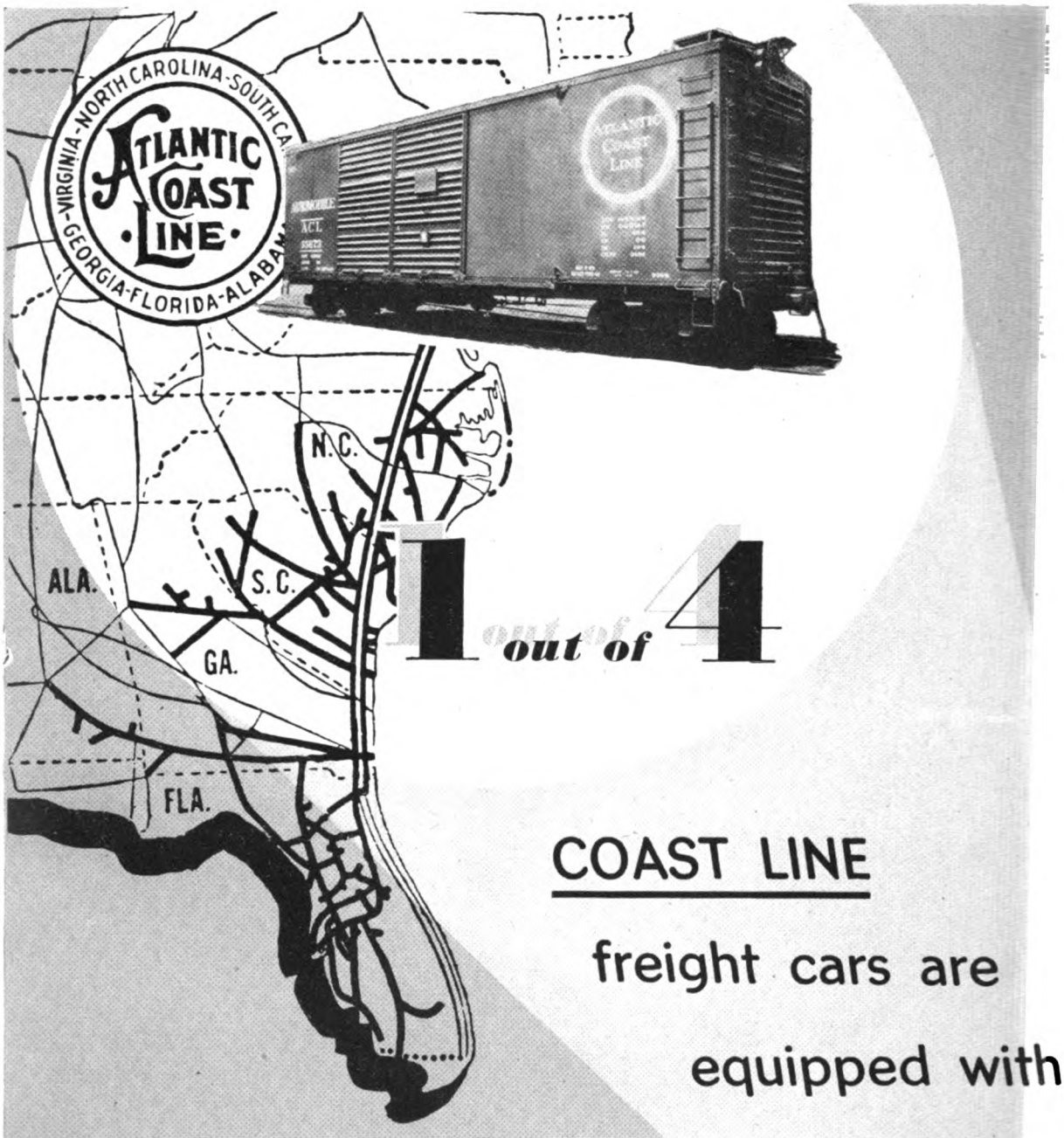

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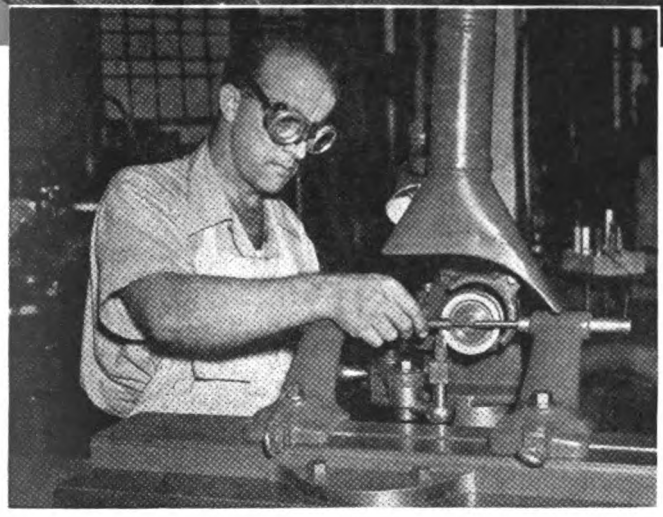

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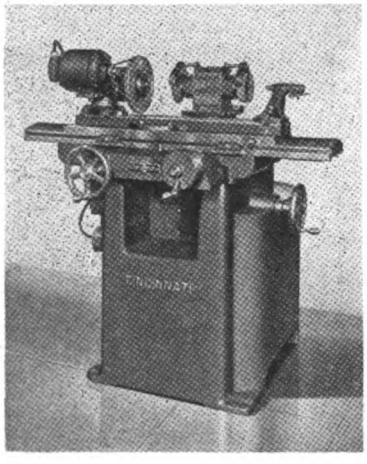

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LOCOMOTIVE No. 6000, delivered by the American Locomotive Company to the New York Central early this spring, is a major step forward in the progress of the New York Central's equipment engineering department in steam locomotive development during the past twenty years. The Class J-1 4-6-4 type, was introduced in 1927. This was followed by the Class J-3 ten years later. Then came refinements in the Class L 4-8-2 freight locomotives which have adapted those more recently built to high-speed passenger service as well as to freight service. The Class L-4 locomotives, the most recently built of the type, were first delivered in 1942.

The development of the Class S-la locomotive, known locally as the Niagara type, began with the intention of bringing out a new class of L type locomotives with some expansion of boiler capacity. As the development progressed, however, it became evident that to attain the full possibilities of increased boiler capacity a 4-8-4 type wheel arrangement was required. The Class S 4-8-4 locomotive is expected to develop not less than 6,000 i. hp. This compares with a maximum indicated horsepower of nearly 4,800 for the Class J-3 4-6-4 locomotive and 5,400 for the Class L-4 4-8-2 type.

The Boiler

The boiler has been increased both in diameter and length from that of the Class L-4 locomotive. The outside diameter of the third course is 100 in. and the top of the boiler is practically at the clearance limit, which

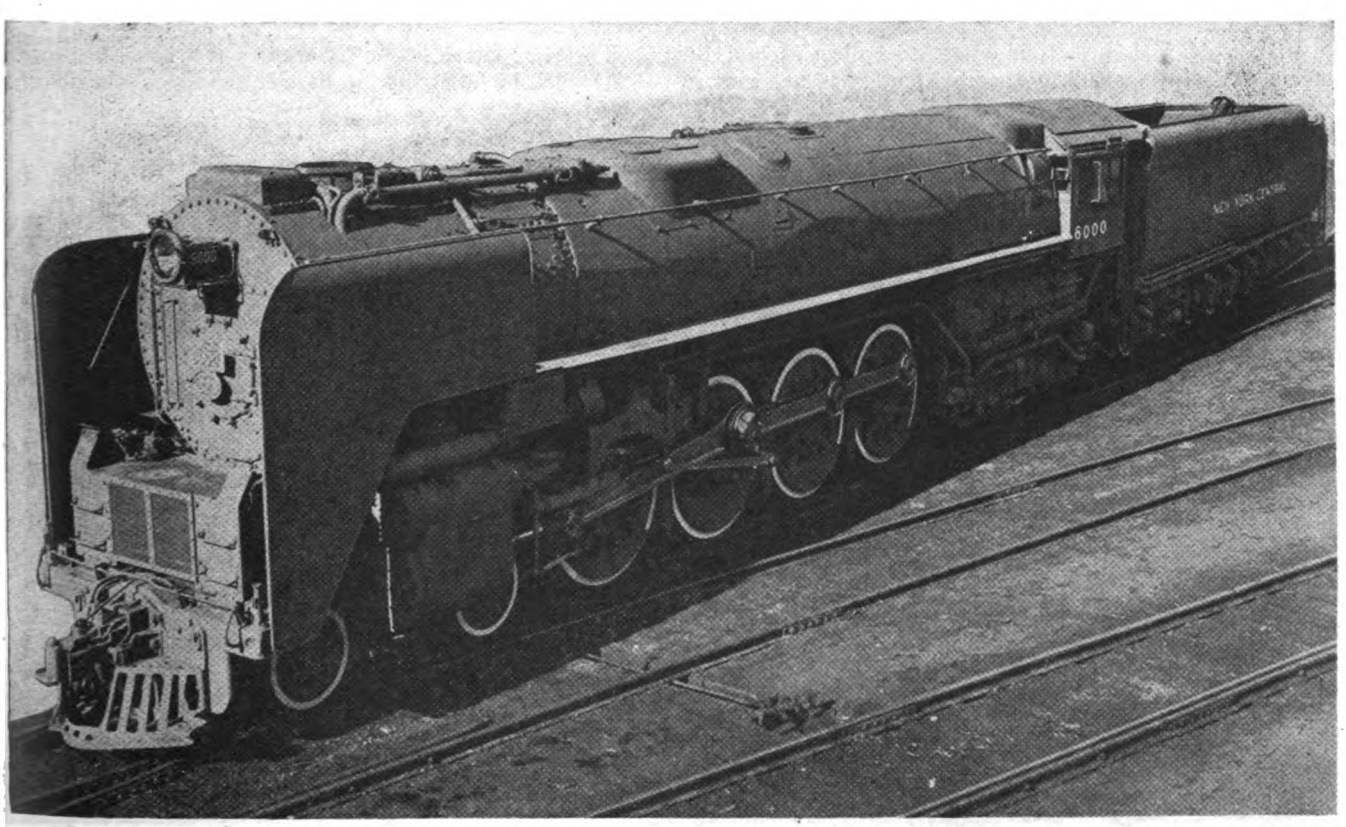


Table I—General Dimensions, Weights and Proportions of the New York Central 4-8-4, Class S-1a Locomotive

Road class	S-1a
Road number	6000
Date built	March, 1945
Steam pressure, lb. per sq. in.	275*
Drivers, diameter, in.	75*
Cylinders, number, diameter and stroke, in.	2—25 x 32
Rated tractive force engine, lb.	62,330*
Valve gear, type	Baker
Valves, piston, diameter, in.	14
Maximum travel, in.	8½
Steam lap, in.	1 9/16
Exhaust clearance, in.	3/16
Lead, in.	5/16
Cut-off in full gear, per cent	83
Dimensions:	
Height, rail to top of stack, ft.-in.	15—1¾
Height, rail to center of boiler, ft.-in.	10—7½
Width overall, ft.-in.	10—7½
Cylinder centers, in.	92
Wheel bases, ft.-in.:	
Driving	20—6
Rigid	13—8
Engine, total	48—9
Engine and tender, total	97—2½
Weights, lb.:	
Front truck	91,000
Drivers	275,000
Trailing truck:	
Front	48,000
Rear	57,000
Engine, total	471,000
Tender (⅔ loaded)	337,400
Weight on drivers, per cent weight of engine	58.39
Weight on drivers ÷ tractive force	4.41
Tender:	
Type	Bed
Water capacity, gal.	18,000
Coal capacity, tons	46
Wheel arrangement	4-10-0

* These dimensions apply to the locomotive as delivered by the builder with 75-in. driving wheels. When these wheels are replaced with the 79-in. set the working boiler pressure will be increased to 290 lb. per sq. in. and the rated tractive force will be 62,400 lb.

precludes the employment of a steam dome. Grate area has been increased from 75.3 sq. ft. to 100 sq. ft. and the depth of the combustion chamber from 63 to 92½ in. The length of the tubes has been reduced from 20 ft. 6 in. to 19 ft. The boiler has been designed for a maximum working pressure of 290 lb. which is required with the 79-in. driving wheels.

In lieu of a dome, from which to collect steam, the steam dry pipe, closed at the rear end, has a series of 28 1-in. transverse slots across the top, each with a clear chord length of 5 in. The dry pipe, 11 in. in inside diameter, has an internal cross-sectional area of 95 sq. in. The steam gathering area through the slots is 140 sq. in.

Baffle plates which extend out below these openings on each side of the steam pipe have proved effective in preventing moisture carryover. These are 50 in. in length and are welded at the ends to vertical end plates which fit over the steam pipe and extend up close to the inside of the boiler shell at the top.

The shell courses of the boiler are carbon-silicon steel. This material is estimated to have permitted a reduction in weight of about 7,000 lb. as compared with carbon steel. Construction details follow closely the boiler of the L-4 class. The inside firebox is welded throughout. The circumstantial wrapper and outside throat-sheet seams and the butt joints of shell courses at ends of longitudinal seams are seal welded. The usual seal welding has been made in the vertical seams of the outside firebox.

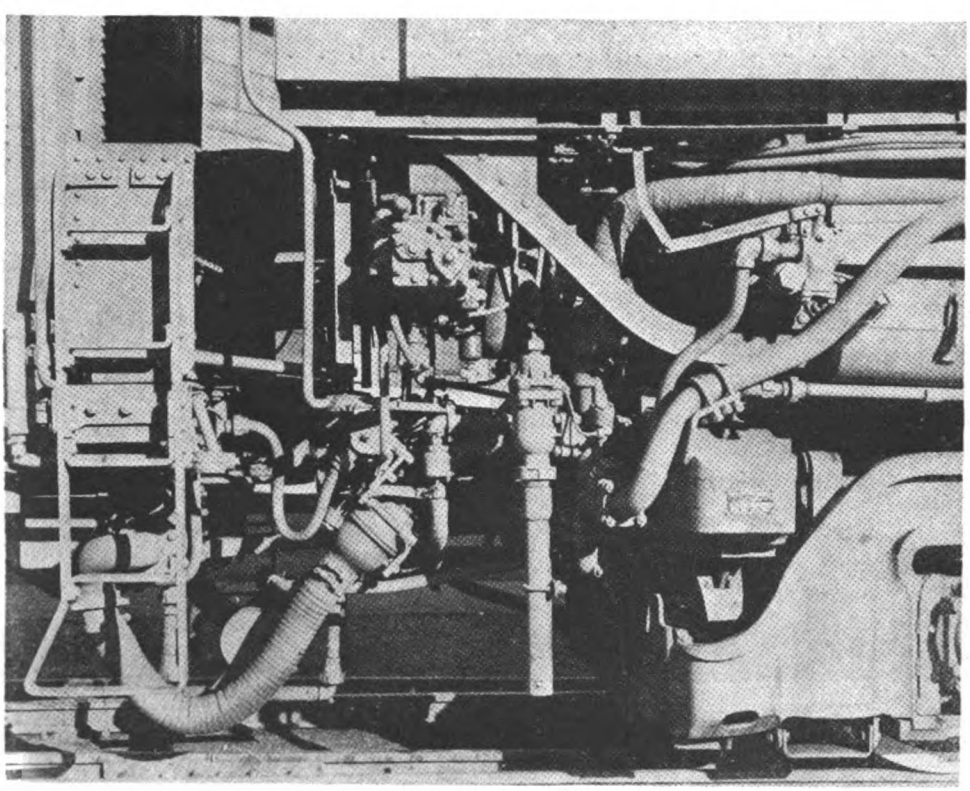
The American arch is carried on five 4-in. arch tubes. Coal is fired by a Standard HT stoker with the engine on the tender. The grates are Firebar. The feedwater equipment consists of the Worthington No. 7SA feedwater heater and a Nathan No. 4000 injector on the right side. A Barco low-water alarm is applied.

One of the bottlenecks in the maintenance of uninterrupted road service of steam locomotives in modern, fast long-distance train movement is limited ash-pan capacity. The ash pan on the S-1a locomotive has a volume of 86 cu ft. with four hoppers. That on the L-4a was limited to 50 cu. ft. The ash-pan volume, in cubic feet per square foot of grate area, is .86 on the S-1a, .66 on the L-4a and .76 on the J-3a locomotives. The body of the pan is of welded construction and the hoppers are cast steel.

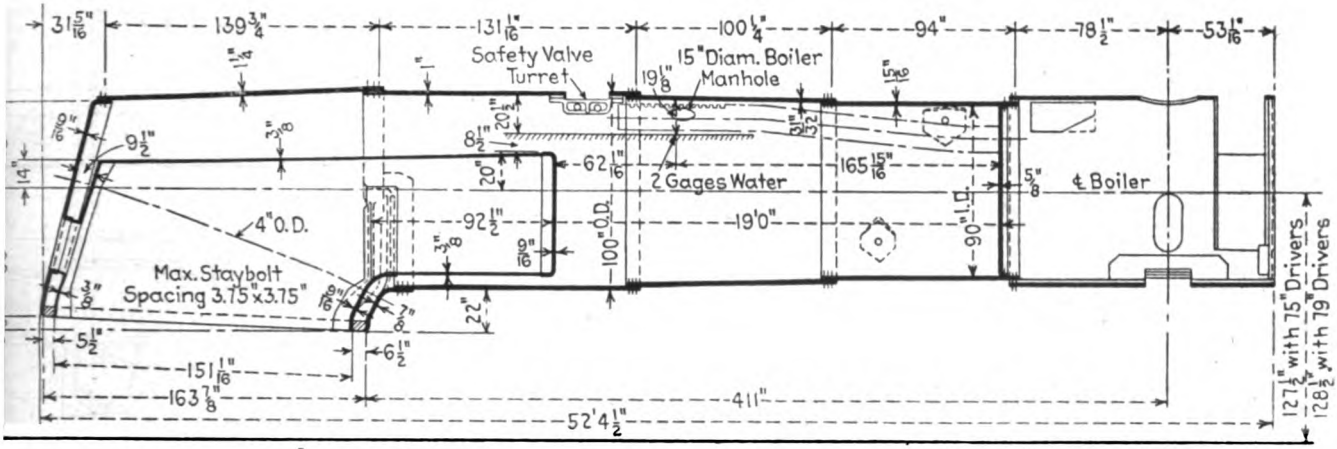
The front ends are the railroad's Selkirk type similar to those on the Class L-4 locomotives.

Running Gear

The foundation of the locomotive is a cast-steel engine bed which includes the locomotive cylinders with integral



The injector, No. 8-A air-brake distributing valve, and blow-off cock with cylindrical muffler (the end appears behind the injector suction hose) below the right side of the cab

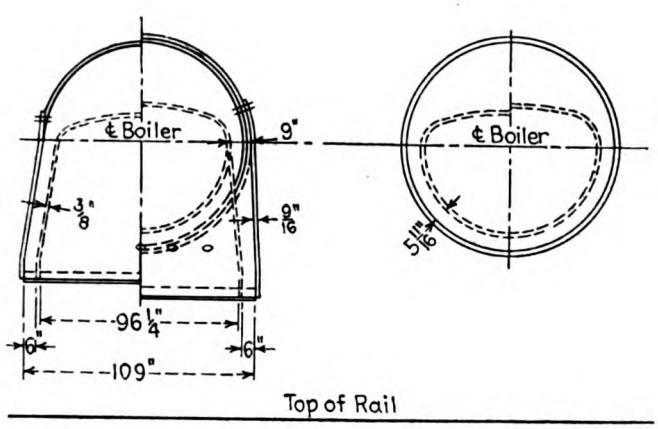


Sectional elevation of the boiler of the New York Central Class S-1a locomotive

Table II—General Dimensions and Proportions of the Boiler

Steam pressure, lb.	275*
Diameter first ring, inside, in.	90
Diameter third ring, outside, in.	100
Sheet thickness, in.:	
Smokebox	1/4
First ring	15/16
Second ring	31/32
Third ring	1
Back head	9/16
Side sheets	9/16
Roof sheet	1 1/4
Furnace door sheet	3/8
Furnace side sheets	3/8
Furnace crown sheet	3/8
Combustion chamber	3/8
Front tube sheet	5/8
Back tube sheet	9/16
Firebox length, in.	151 1/16
Firebox width, in.	96 1/4
Water space, front, in.	6 1/2
Water space, back, in.	5 1/2
Water space, sides, in.	6
Combustion chamber length, in.	92 1/2
Arch tubes, number and diameter, in.	5—4
Flues, number and diameter, in.	177—4
Flues, thickness, in.	No. 9 BWG
Tubes, number and diameter, in.	55—2 1/4
Tubes, thickness, in.	No. 11 BWG
Length over tube sheets, ft.-in.	19—0
Net gas area through tubes and flues, sq. ft.	10.57
Superheater, type	E
Fuel	Soft coal
Grate area, sq. ft.	100
Feedwater heater, type	Worthington
Heating surfaces, sq. ft.:	
Firebox and comb. chamber	460
Arch tubes	57
Firebox, total	517
Tubes and flues	4,115
Evaporative, total	4,832
Superheater	1,977
Combined evaporative and superheater	6,609
Boiler proportions:	
Firebox heating surface per cent comb. heating surface	7.82
Tube-flue heating surface pre cent comb. heating surface	62.26
Superheat surface per cent comb. heating surface	29.91
Firebox heating surface ÷ grate area	5.17
Tube-flue heating surface ÷ grate area	41.15
Superheat surface ÷ grate area	19.77
Combined heating surface ÷ grate area	66.09
Gas area, tubes-flues ÷ grate area	0.1057
Evaporative heating surface ÷ grate area	46.32
Tractive force ÷ grate area	623
Tractive force ÷ evap. heating surface	13.46
Tractive force ÷ comb. heating surface	9.43
Tractive force × dia. drivers ÷ comb. heating surface	707.5

* These dimensions apply to the locomotive as delivered by the builder with 75-in. driving wheels. When these wheels are replaced with the 79-in. set, the working boiler pressure will be increased to 290 lb. per sq. in. and the rated tractive force will be 62,400 lb.



Cross-sections of the boiler

back cylinder heads, the air-pump brackets, and the main reservoirs. The boiler is supported by sliding shoes at the second course and at the front and rear ends of the firebox.

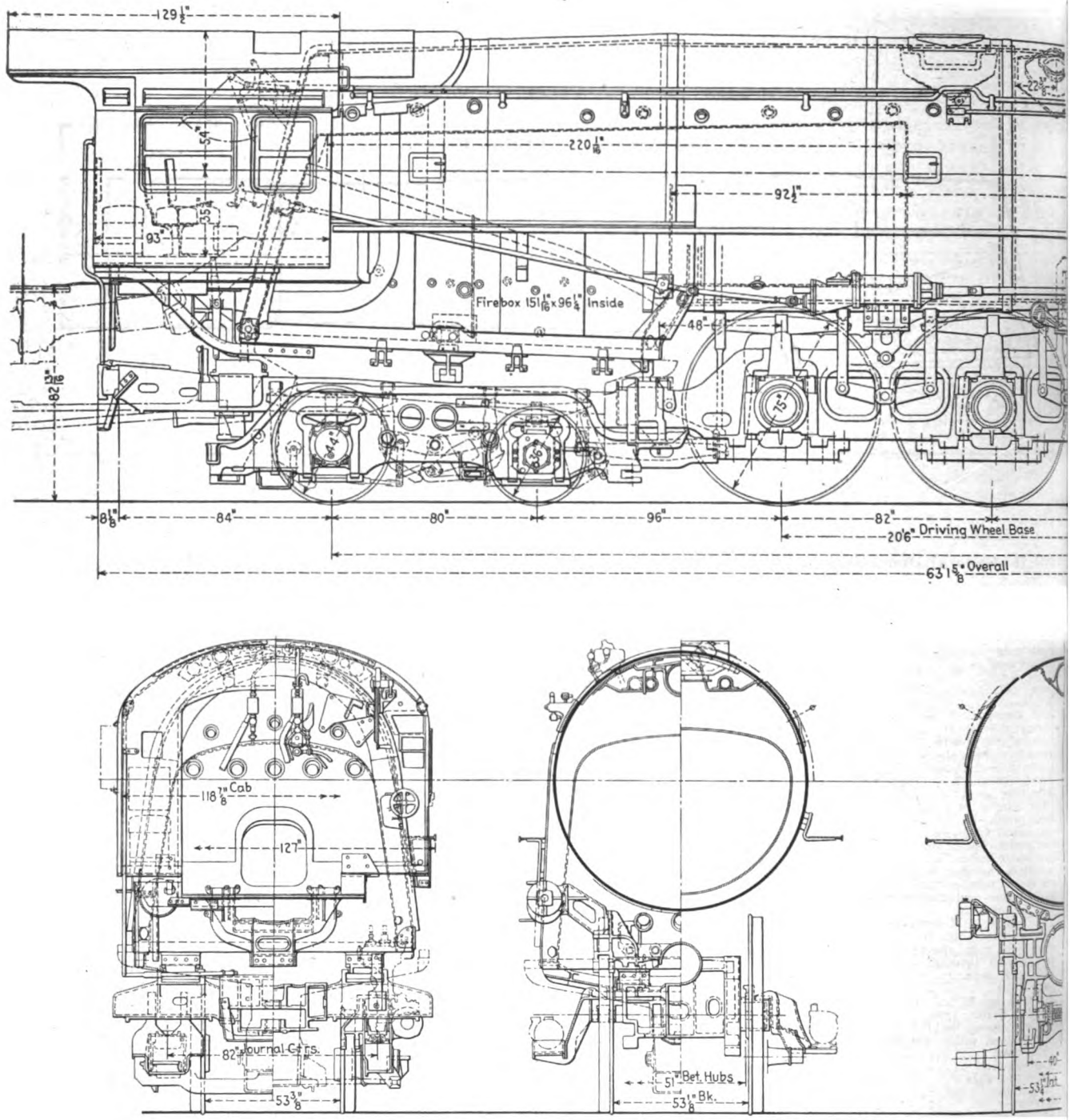
The driving wheels are mounted on hollow-bored axles and the roller-bearing assemblies are of the Timken split-housing type with two-roll bearings. Alco lateral motion devices are applied on the front and intermediate pairs of driving wheels. They permit a controlled lateral of 5/8 in. and 5/16 in. per side, respectively.

The engine truck has a roller centering device for the bolster and a combination coil and elliptic spring suspension. The truck wheels are 36 in. in diameter and the inside journals are fitted with Timken roller bearings. The front wheels of the four-wheel trailing truck are 36 in. and the rear 44 in. in diameter. These axles are fitted with outside Timken roller-bearing boxes.

The locomotive is driven by a complete set of Timken roller-bearing rods. These include bearings on the crosshead wrist pin and the four crank pins. The roller bearings are mounted on the crank pins and the rods with spun-brass liners are slipped over the outside bearing races. A single rod on each side leads from the main to the front driving wheels; in order, outside of this on the main pin, are a main-to-intermediate side rod, the main rod back end, and another main-to-intermediate side rod. Between the ends of the two main-to-intermediate rods on the intermediate pin is the front end of the back side rod.

The one-piece pistons are of electric cast steel designed for the railroad's lip-type packing rings. The hollow piston rod is of Timken alloy steel with the Timken type of crosshead connection. The crosshead shoe is of aluminum. The guides are not attached to the rear cylinder heads.

In counterbalancing the locomotive only the main driving wheels are cross-balanced. The total revolving weights on each side of the locomotive amount to 3,064 lb. and the reciprocating weights to 1,547 lb., of which 25 per cent is balanced. This requires an average overbalance per wheel of about 97 lb. and leaves a recipro-



Cross-sections and elevation of the New

cating unbalance per ton of total engine weight of 4.94 lb.

The reciprocating parts and crank pins, with the exception of the front, are chrome-nickel-molybdenum steel. The main and side rods are manganese-vanadium, and the locomotive axles carbon-vanadium steel. The crank pins in the front drivers are of carbon steel.

Loop type hangers are used in the driving and trailer spring rigging of this locomotive. Coil springs are inserted in the hangers at the engine-bed connections in from of the No. 1 driving wheels and at the connection to the trailer frame back of the rear trailing-truck axle.

Steam Distribution System

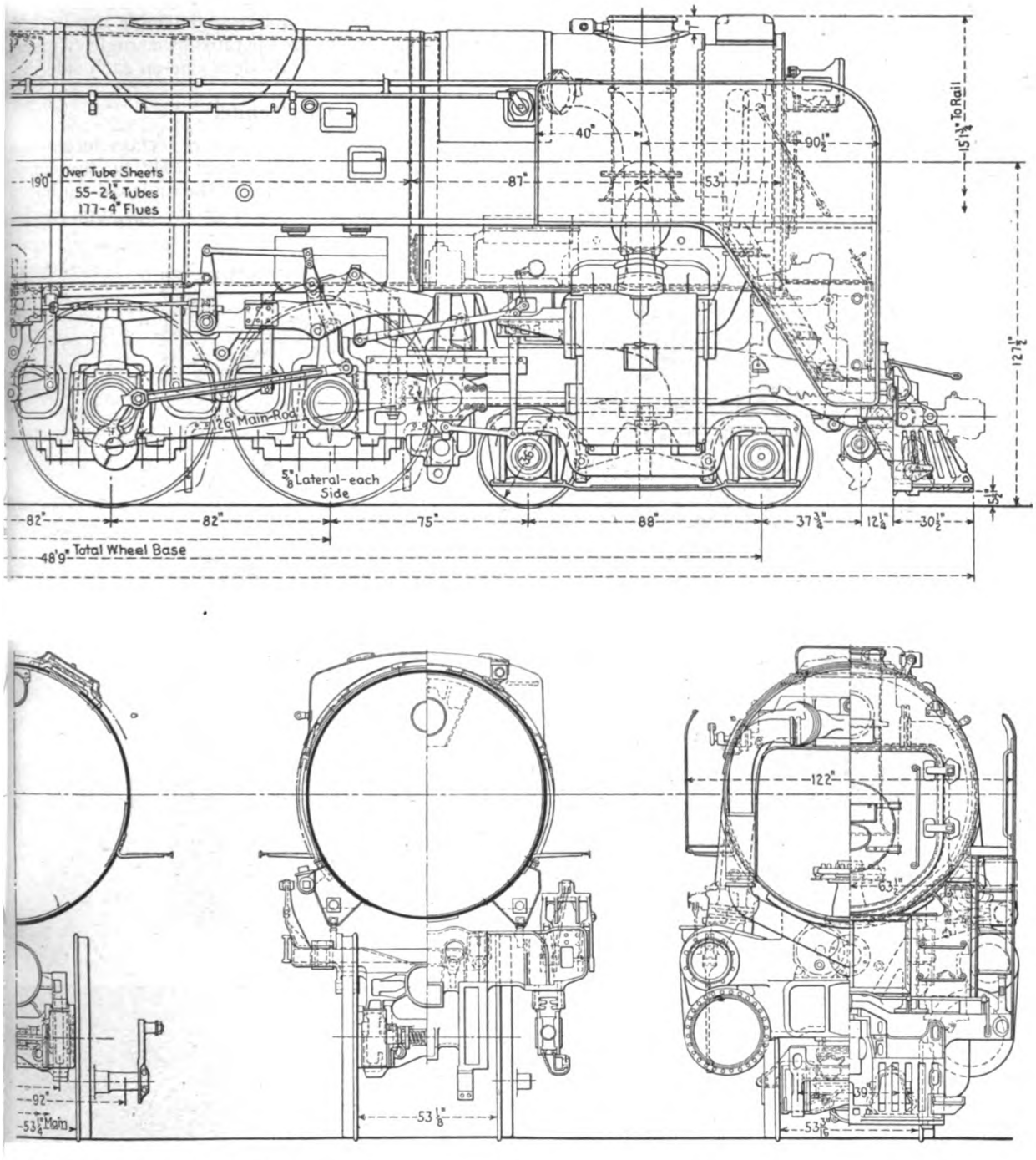
The 14-in. distribution valves are driven by the Baker valve gear, with needle bearings. This gear provides a maximum travel of 8½ in. The valve motion is controlled by the Franklin Precision reverse gear which is attached to a bracket on the engine bed and not to the boiler. The Hunt-Spiller lightweight valves are fitted with bronze Duplex lip valve rings.

The larger boiler diameter permitted better superheater proportions. Particular attention was given throughout the steam passages from the boiler to the exhaust to bring the pressure drop to the minimum.

The minimum area through the superheater tubes is 86.6 sq. in. This compares with 70.5 sq. in. on the L-4 class. In the table is shown a comparison of the cross-sectional areas of the chain of steam passages.

Lubrication

One Nathan DV-8 42-pint lubricator is applied on the right side of the locomotive. From this lubricator are



York Central Class S-1a locomotive

two feeds to the steam pipes, two feeds to the cylinders, one feed, with a four-way distributor, to the guides, and one feed to the stoker engine.

The chassis lubrication is by Alemite and Rex oil fittings. Alemite soft-grease fittings are used on the valve gear, including the Valve Pilot fittings, on the radial buffer, on the valve-stem crossheads, on the water-scoop piston rod, and on the lateral-motion-device spring seats. Alemite fitttings using valve oil are applied on the driving-box pedestal faces. Rex oil fittings are installed for engine-truck-box, trailer-truck-box, and tender-truck-box pedestals, and on the crank pins and roller-bearing wrist pins. The power reverse-gear cylinder is lubricated by a Norgren No. 401-4 lubricator with Alemite soft-grease fittings on the reverse-shaft bearings and the reach-rod connection.

Alemite hard grease fittings are applied on the back ends of the eccentric rods.

Engine oil is used to lubricate the firebox expansion-shoe castings, engine-truck and tender-truck center plates, and miscellaneous points.

Spring-rigging pin and loop connections are lubricated with Alemite soft-grease fittings.

Cab and Cab Fittings

The cab is built of aluminum plates throughout and is entirely supported on the boiler by cantilever beams. Aluminum is also used for such parts as running boards, front platform and air-pump shield, the smoke-lifting shields at the sides of the front end, casings, gauge boards, etc.

Two saturated-steam turrets are mounted on the boiler

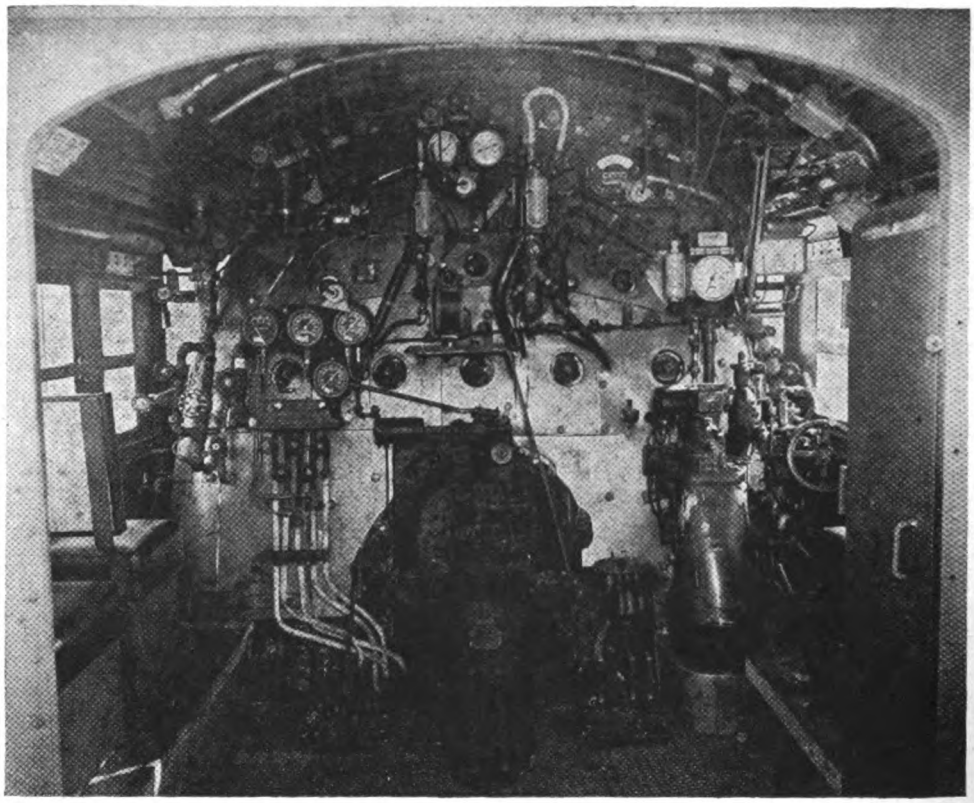
	J-3	L-3—L-4	S-1a
Internal area of dry pipes	56.7	69.0	95.0
Area of dry-pipe slots	...	...	140.0
Minimum area through superheater tubes	61.8	70.5	86.6
Area past throttle valves, wide open	59.5	73.6	98.4
Internal area of one steam pipe	50.2	56.7	63.6
Port area one valve bushing at 50 per cent cut-off	30.1	29.2	30.5
Minimum area of passage, one end of cylinder to valve bushing	42.9	51.8	53.2
Port area of one valve bushing	76.3	79.6	90.4
Exhaust port area of one valve bushing at end of piston stroke	70.0	69.3	70.9
Available exhaust area around valve bushing, end of piston stroke	50.0	56.0	57.0
Exhaust area at end of valve bushing	76.0	73.1	75.0
Exhaust area one side of exhaust stand	52.0	52.0	62.0
Area exhaust nozzle	38.5	39.9	44.2
Area one cylinder	397.6	530.9	490.9

the smokebox. A fin-tube aftercooler is placed in the air line between the two main reservoirs. Removable portions of the front deck permit access to the air-filters. The air compressors are built with integral lubricators.

All wheels on the locomotive and tender are braked. The engine-truck brakes are operated by a single cylinder; the driver brakes, by two cylinders, one on each side.

The Tender

When the characteristics of the S-1 class locomotive were first receiving consideration in 1942 by the equipment engineering department of the railroad authority was secured to build five tenders of the bed type carried

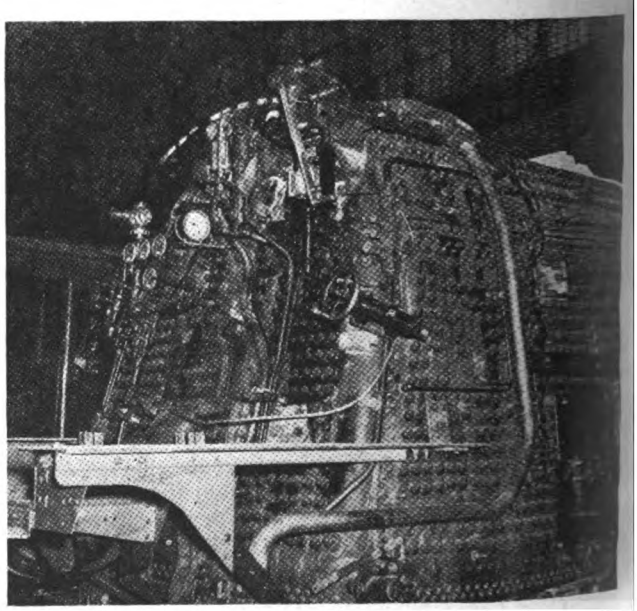


just ahead of the cab, one on the right and the other on the left side. The right-hand turret provides connections for the cab radiator, the smoke consumer, the coal pusher, the headlight generator, and the injector. From the left turret steam is taken for the steam-heat reducing valve, the stoker, the feedwater pump, and the coal sprinkler. Superheated steam is furnished for the blower and the locomotive whistle. The whistle is mounted beside the stack on the smokebox.

The headlight generator is placed back of the rear driver on the right side of the locomotive. The exhaust is piped to the ash pan.

The locomotives are equipped with a Vapor 2½-in. steam-heat reducing valve. The sand-box arrangement is unusual. On top of the boiler is an aluminum sand box of limited capacity from which two rectangular tubes extend down the sides of the boiler under the jacket to right and left steel boxes located under the running boards. The New York Air Brake sand traps at the lower ends of these sand boxes distribute sand in front of the front and main drivers.

The air brakes are the New York Schedule 8ET with relay valve. The two 8½-in. cross-compound air com-



The backhead of the boiler in the erecting shop

mounted in pedestals on the tender-bed casting. The objective of this design was to provide approximately the same coal and water capacity as that of the large tenders of the conventional type carried on two six-wheel trucks which were received with the Class L-3 and L-4 4-8-2 type locomotives, but to have a wheel base about 6 ft. shorter. This would permit the 4-8-4 type locomotive, with its longer engine wheel base, to be handled on the 100-ft. turntables generally available on the main line between New York and Chicago.

These tenders have a coal capacity of 46 tons and carry 18,000 gal. of water. Incorporated in them, as the result of comprehensive studies and road tests, is the venting system for scooping water without reducing speed similar to that built into the large tenders behind the L-4 class locomotives.*

The tanks of these tenders are of conventional riveted construction. The ratio of loaded to light weight is some-

* The high-speed water scoop and the system of venting in these tenders were described in the October, 1944, *Railway Mechanical Engineer*.

with two six-wheel trucks.

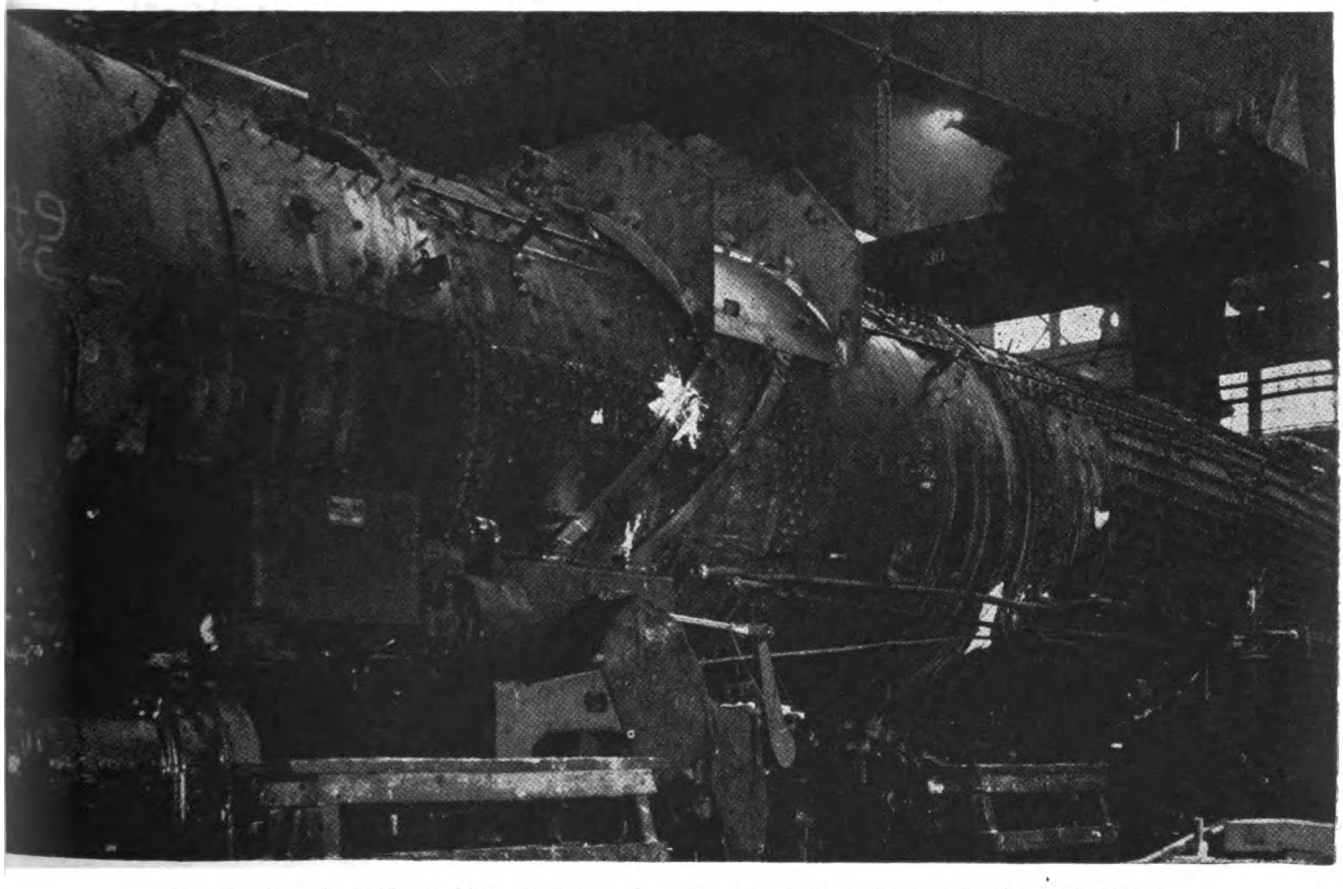
The tender wheels are all 41 in. in diameter. Timken journal bearings are installed throughout.

Further Developments

For the purpose of investigating the effect of driving-wheel diameter on locomotive performance locomotive No. 6000 was delivered to the railroad with driving wheels 75 in. in diameter, but a set of 79-in. drivers was provided for later use. The original intention had been to conduct performance and capacity tests of the locomotive while equipped with the 75-in. driving wheels, then to replace these with the 79-in. drivers, increasing the boiler pressure to maintain the same tractive force, and then to place the locomotive in regular service. These plans were changed, however, and the locomotive was placed in road service with the 75-in. drivers. After making several trips between Harmon and Chicago, it was placed in Harmon-Cleveland service for several weeks. Then the 79-in. wheels were installed early in July and the locomotive was

Table IV—Axles, Bearings, Wheels and Tires

	Axles				Wheels or Tires			Wheel Centers		
Location	Material	Manufacturer	Bearings	Journal size, in.	Type and material	Manufacturer	Diameter, in.	Type	Manufacturer	Diameter, in.
Front truck	Carbon-vanadium	Shop made	Timken	8¼	Rolled steel	Carnegie-Illinois	36	.....	.....	..
Drivers, main	Carbon-vanadium	Shop made	Timken	13	.....	American Loco. Co., Railway Steel Spring Div.	75	Boxpok	G.S.C.	68
Drivers, other	Carbon-vanadium	Shop made	Timken	12⅛	.....	American Loco. Co., Railway Steel Spring Div.	75	Boxpok	G.S.C.	68
Trailer, **front**	Carbon-vanadium	Shop made	Timken	6½	Rolled steel	Carnegie-Illinois	36	.....	.....	..
Trailer, rear	Carbon-vanadium	Shop made	Timken	7½	Rolled steel	Carnegie-Illinois	44	.....	.....	..
Tender	Plain carbon steel	Shop made	Timken	6½	Rolled steel	Carnegie-Illinois	41	.....	.....	..



Pipes of rectangular section lead from the top sand box to lower sand storage boxes under the running board

Partial List of Materials and Equipment on the New York Central Class S-1a 4-8-4 Type Locomotive

Engine bed; engine and trailer trucks; bumper; pilot	General Steel Castings Corp., Eddystone, Pa.
Lateral motion device on front and intermediate drivers	American Locomotive Co., New York
Radial buffer; power reverse gear	Franklin Railway Supply Co., Inc., New York
Driving boxes; crank pins (main, intermediate and rear); roller bearings on main and side rods and axles; crossheads; crosshead shoes	The Timken Roller Bearing Co., Canton Ohio
Springs, driving	Railway Steel Spring Div., American Locomotive Co., New York
Bearings and brass castings	Magnus Metal Div., National Lead Co., New York
Air brakes and air signal	New York Air Brake Co., Watertown, N. Y.
Brake shoes	American Brake Shoe Company, New York
Automatic train control	General Railway Signal Co., Rochester, N. Y.
Piston rod, hollow	The Timken Roller Bearing Co., Canton, Ohio
Piston packing; rod and valve-stem packing	U. S. Metallic Packing Co., Philadelphia, Pa.
Piston valve; gun-iron castings; cylinder and valve bushings	Hunt-Spiller Manufacturing Corp., Boston, Mass.
Cylinder cocks; ashpan flusher cock; right blower valve; blow-off cocks; gauge-glass guards	The Okadee Co., Chicago
Valve gear	The Pilliod Company, New York
Left blower valve	The Lunkenheimer Co., Cincinnati, Ohio
Lubricator, mechanical	Nathan Manufacturing Co., New York
Lubrication—grease, fittings	Alemite Div., Stewart-Warner Corp., Chicago
Power reverse-gear lubricator	C. A. Norgren Co., Denver, Colo.
Brick arch	American Arch Co., Inc., New York
Lagging	Johns-Manville Sales Corp., New York
Smokebox hinges	The Okadee Co., Chicago
Staybolts, flexible	Flannery Bolt Co., Bridgeville, Pa.
Steam-heat reducing valve	Vapor Car Heating Co., Inc., Chicago
Superheater; pyrometer	The Superheater Co., New York
Throttle lever and throttle valve	American Throttle Co., New York
Washout plugs	Huron Mfg. Co., Detroit, Mich.
Injector; boiler checks	Nathan Manufacturing Co., New York
Feedwater heater	Worthington Pump and Machinery Corp., Harrison, N. J.
Feedwater-heater pump control valve	The Lunkenheimer Co., Cincinnati, Ohio
Piping	A. M. Byers Co., Pittsburgh, Pa.
Steam-pipe casing	American Locomotive Co., New York
Steam pipe to headlight generator	Seamlex Co., Inc., Long Island City, N. Y.
Blow-off mufflers	National Aluminate Corp., Chicago
Stoker	Standard Stoker Co., Inc., New York
Stoker by-pass control valve	The Lunkenheimer Co., Cincinnati, Ohio
Fire door	Standard Fire Door Co., Toledo, Ohio
Coal sprinkler; steam and air gauges; safety valves	Manning, Maxwell & Moore, Inc., Locomotive Equipment Div., Bridgeport, Conn.
Low-water alarm	Barco Manufacturing Co., Chicago
Grates	Waugh Equipment Co., New York
Running boards	Aluminum Co. of America, Pittsburgh, Pa.
Cab windows	O. M. Edwards, Inc., Syracuse, N. Y.
Headlight; conduit and wiring fittings; turbo generator	The Pyle-National Co., Chicago
Water columns; whistle	Nathan Manufacturing Co., New York
Whistle blower	Viloco Railway Equipment Co., Chicago
Bell ringer	Railway Service & Supply Corp., Indianapolis, Ind.
Sanders	New York Air Brake Co., Watertown, N. Y.
Speed and cut-off indicator and recorder	Valve Pilot Corp., New York
Marker lamps	Lovell-Dressel Co., Arlington, N. J.
Steam-heat connections; pressure reducing valves	Vapor Car Heating Co., Inc., Chicago
Flexible connections between engine and tender	Barco Manufacturing Co., Chicago
Tender:	
Brake beams; clasp brake; slack adjuster	American Steel Foundries, Chicago
Driver brake	American Brake Div., Westinghouse Air Brake Co., Swissvale, Pa.
Coal pusher	Standard Stoker Co., Inc., New York
Pilot and tender couplers	National Malleable and Steel Castings Co., Cleveland, Ohio
Draft gear	Waugh Equipment Co., New York
Strainer	The Okadee Co., Chicago
Tank valve	Crane Co., Chicago
Paint	E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

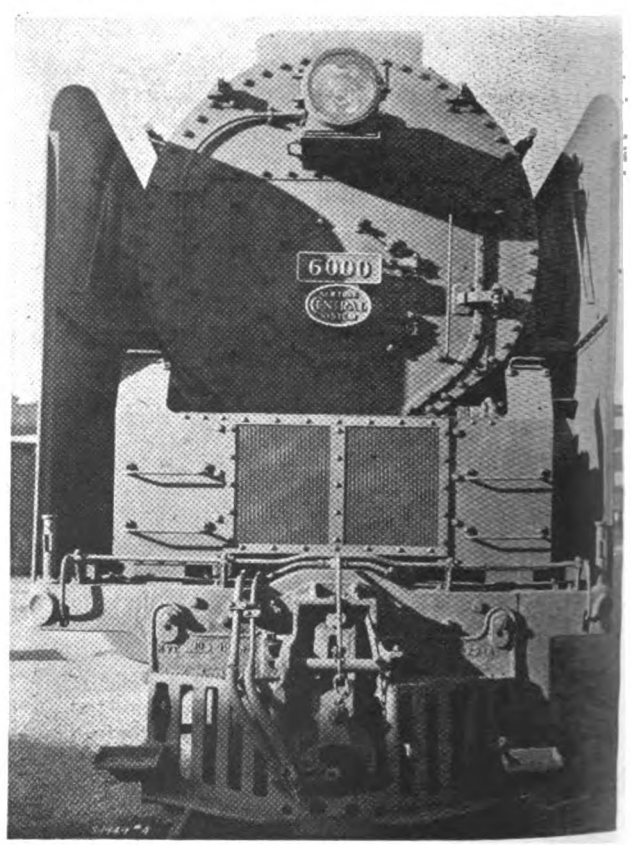
assigned to one side of the Commodore Vanderbilt between Harmon and Chicago. Here it is running at the rate of about 27,000 miles a month and up to the middle of August had accumulated a total of about 60,000 miles. The Commodore Vanderbilt is a heavy train with a number of stops and is considered a hard run. So far the locomotive is said to have made easy work of it.

About October 1, 1945, locomotive No. 6000 will be withdrawn from service for complete boiler performance and capacity tests at Selkirk which will be followed early in 1946 by road tests to determine maximum capacity and efficiency of the locomotive.

Before locomotive No. 6000 was completed an order had already been placed for 25 additional S-1 locomotives. These locomotives, Class S-1b, are now being delivered. Because of the inability to test the S-1a locomotive before the others were ordered, the length of the combustion chamber in the boilers of the latter have been reduced from 92½ in. to 81¼ in. and the tubes and flues correspondingly lengthened. These locomotives have 79-in. driving wheels and the cylinder diameter has been increased from 25 to 25½ in. to accommodate a working pressure of 275 lb.

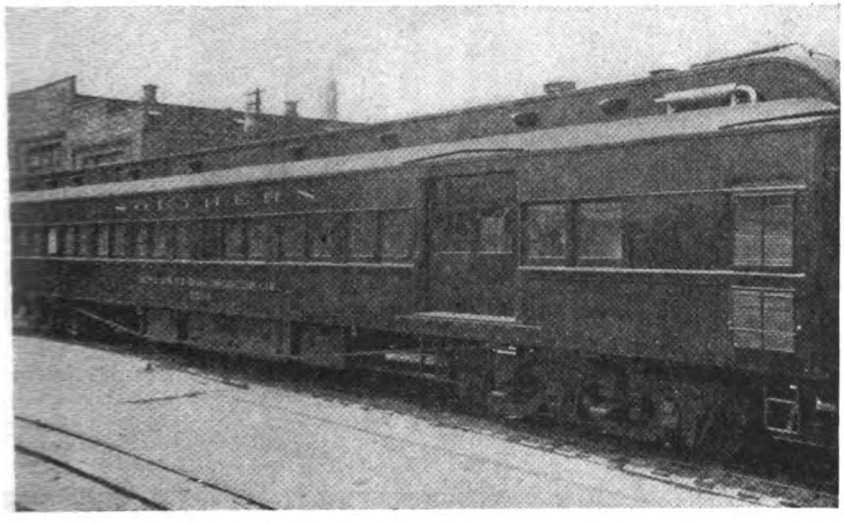
A further change in the S-1b locomotive is the trailer which has two pairs of 41-in. wheels. This change from 36-in. front and 44-in. rear wheels has permitted a further increase in ash-pan volume to 98 cu. ft. and has permitted the design of a pan with better slopes.

A twenty-seventh locomotive will be built to the same proportions as the 25 S-1b class. It will differ from them in that the Franklin poppet-valve system of steam distribution will be installed. This locomotive will be designated as Class S-2a and is to be subjected to comprehensive acceleration, capacity and performance tests for direct comparison with the S-1 class, which has large piston valves and Baker valve gear.



Southern's First

Diesel Instruction Car



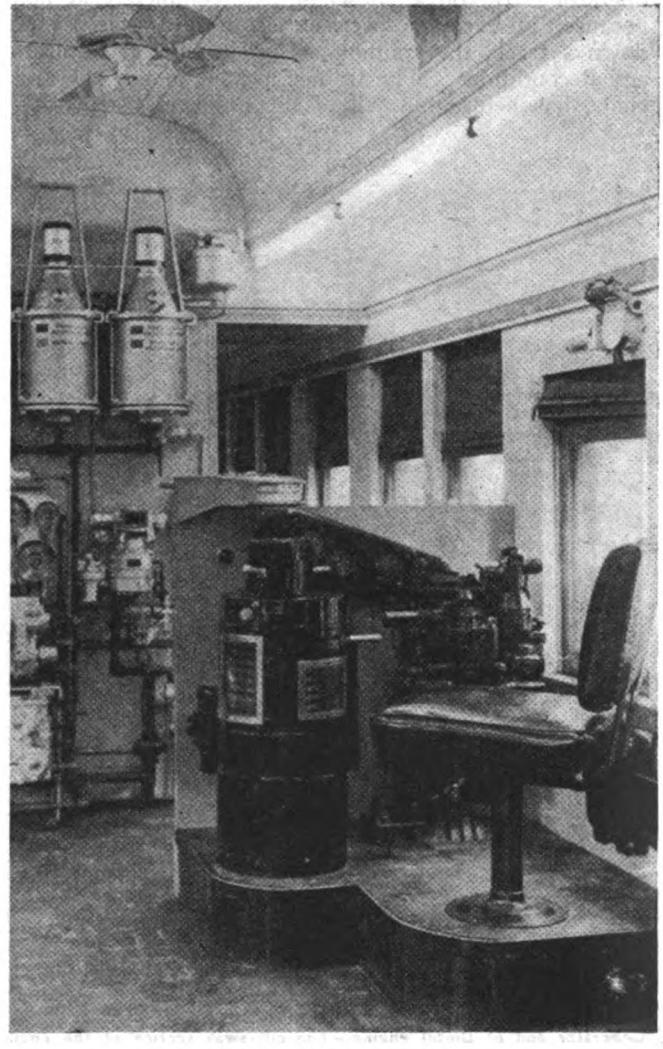
This car, to be followed by others, is employed in training operating and shop personnel on Western Lines in locomotive running repair technique

A DIESEL-LOCOMOTIVE instruction car equipped for training employees in the operation and maintenance of Diesel-electric locomotives has been placed in service on the Western Lines of the Southern. At least two other cars not identical in arrangement with this one are expected to be added, so that there will be one for each of the major operating territories on the railroad.

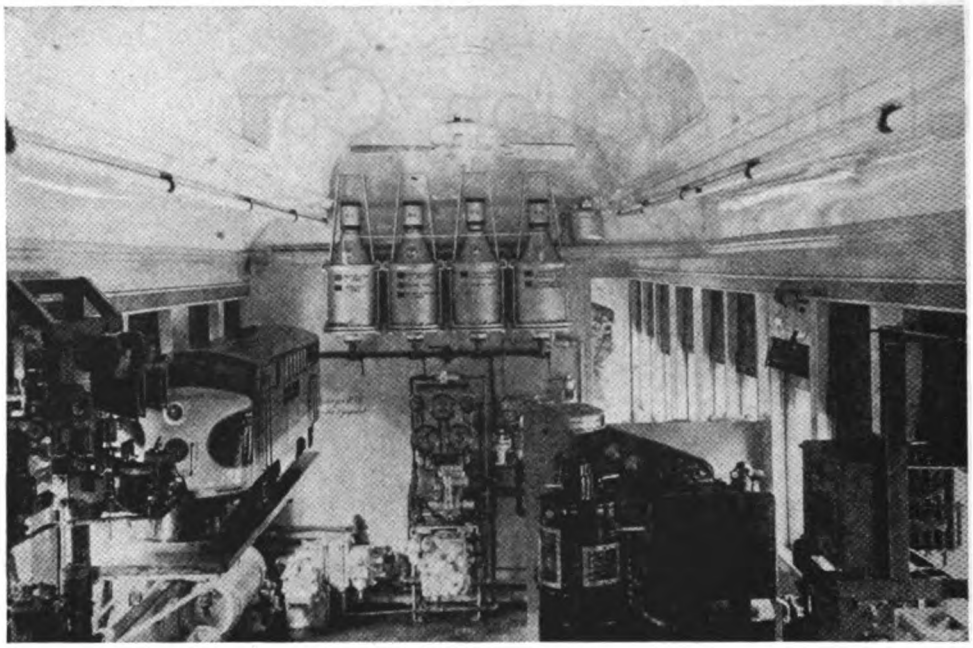
The supervisory forces in the mechanical department, including Diesel foremen, general foremen, road foremen, assistant master mechanics and master mechanics, have all been sent to La Grange, Illinois, for instruction at the school operated there by the Electro-Motive Division of General Motors. The school cars are intended primarily, therefore, to be used in training operating personnel in locomotive handling and shop personnel in trouble-shooting and repair and maintenance procedures.

This car was converted and equipped at the Chattanooga shops with all of the major shop points on the Western lines contributing to its completion by the preparation of one or more of the assembly installations required. The general project was under the supervision of M. D. Stewart, superintendent of motive power for Western lines, and the work was done under the immediate supervision of G. E. Snyder, general Diesel supervisor; M. B. Barnett, chief electrician; G. W. Gardner, air-brake instructor, and E. B. Shehee, general Diesel instructor, all of the Western lines. Mr. Shebee acts as instructor on the car.

Although charts, models and sectional parts will be used for class training where their need is indicated, the car has been so equipped that instruction is carried out so far as possible with actual operating parts or operating models tied in with the operation of these parts. An example of this is in the use of scale model trucks under a model of an A unit of an Electro-Motive 5,400-hp. freight locomotive which have motor-driven wheels which respond to the manipulation of the throttle at the engineer's control stand. This model unit is made to scale of $\frac{5}{32}$ in. per ft. and the body section is mounted on an air-operated piston so that it can be raised clear

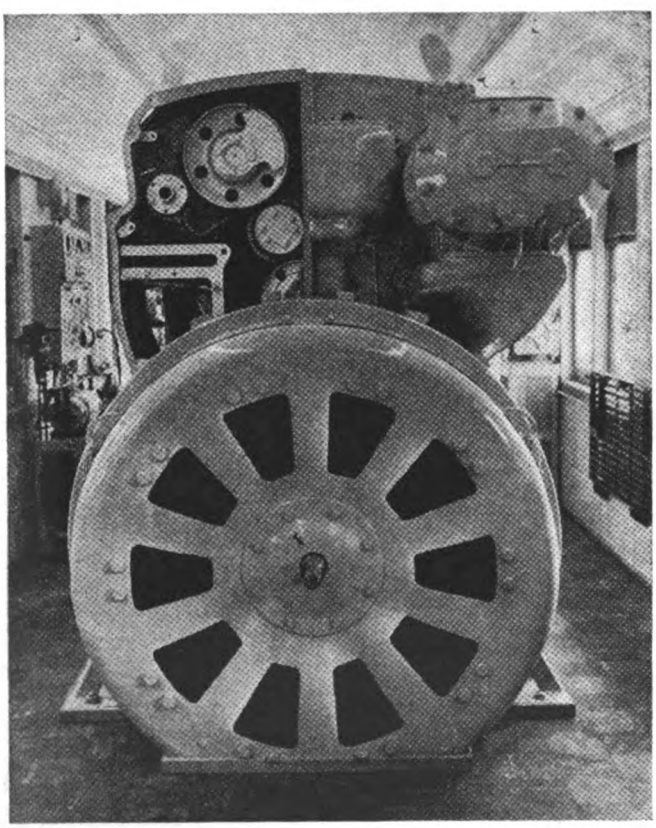


The locomotive controls

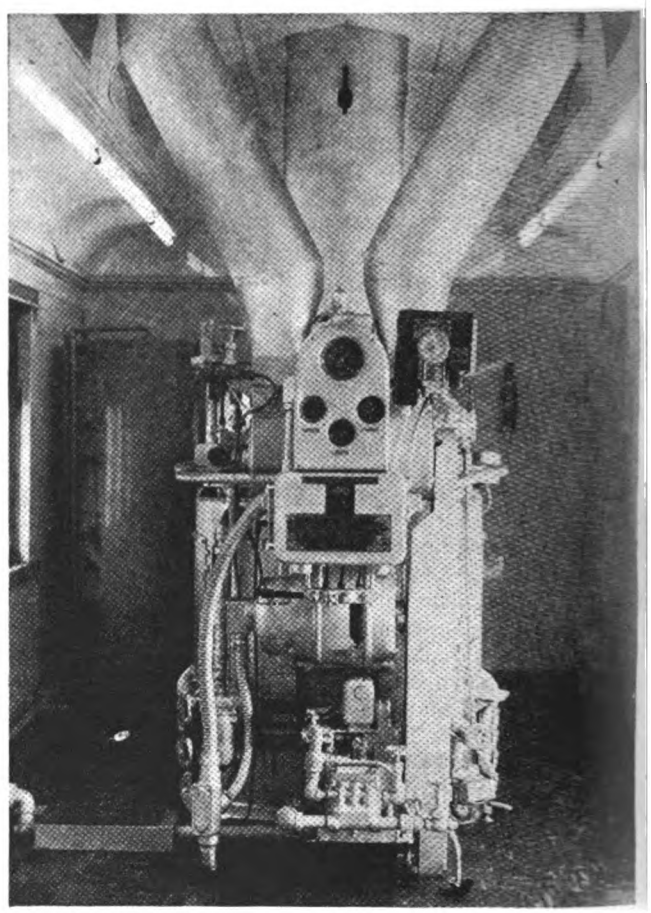


to permit observation of the individually motor-driven trucks.

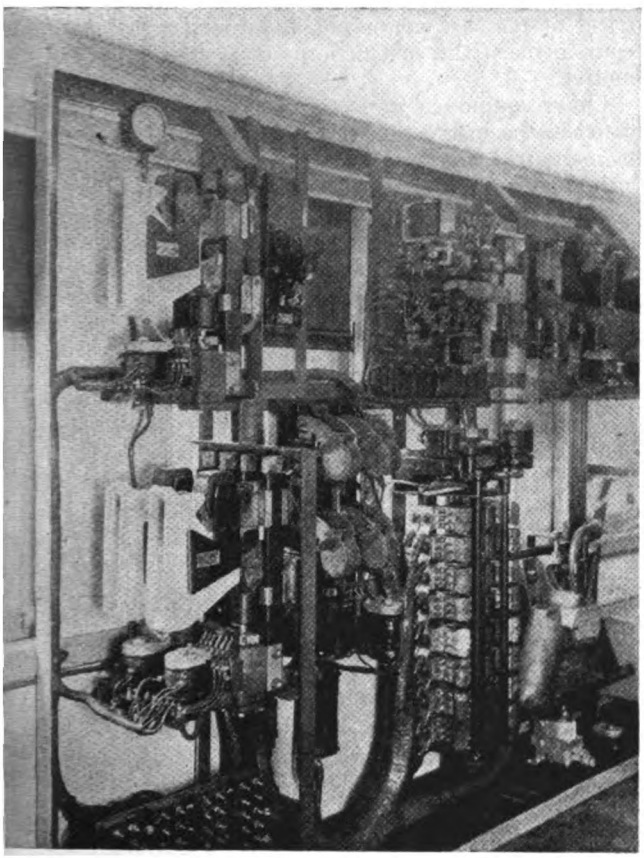
Men being trained in the operation of a Diesel locomotive can move from the instruction car into the operator's seat on a Diesel and be completely at home because, in every respect except a clear view ahead down a track, the training set-up in the car duplicates actual conditions. The trainee, seated in the operator's chair, has before him all of the engineer's controls; a complete control stand with the locomotive throttle, transition lever and reverse lever; the control push-button box with an attendant's call, a master control, the generator field button, a fuel-pump button, defroster-blower button, and buttons for the number lights, gauge lights and classification lights. All of them are operative and control their respective parts just as they do on a locomotive.



Generator end of Diesel engine—The cut-away section of the engine shows some of the gears



The Vapor steam-heating plant



Electrical equipment is complete and operates from cab controls—Trouble shooting is easily taught

The instrument panels are complete and register properly; the transition indicator is a complete and operating unit; the pneumatic control switch, to cut off fuel supply and reduce the speed of engines when a train control, overspeed trip or deadman application occurs, is connected to the operating engine section through the control panel and functions when the operating air-brake equipment is thrown into emergency. The manual reset button, usually referred to as a PC switch, is located in the same relative position in the car as in an actual locomotive cab. A complete cab installation of No. 8 ET brake controls is another part of the cab equipment which is correctly positioned with relation to the engineer's seat and this too is fully operative.

With these full sets of controls it is possible to duplicate any normal and many unusual and unexpected operating difficulties and to familiarize engineers with the functions of their controls and the limitations of their uses. Where road failures occur they will be reenacted in the instruction car for the benefit of the crew involved and all other operators. It is believed that this use of the car alone will aid greatly in reducing the possibility of road failures due to incomplete or improper understanding of the best operating practices under varying conditions.

Controls Operate Actual Parts

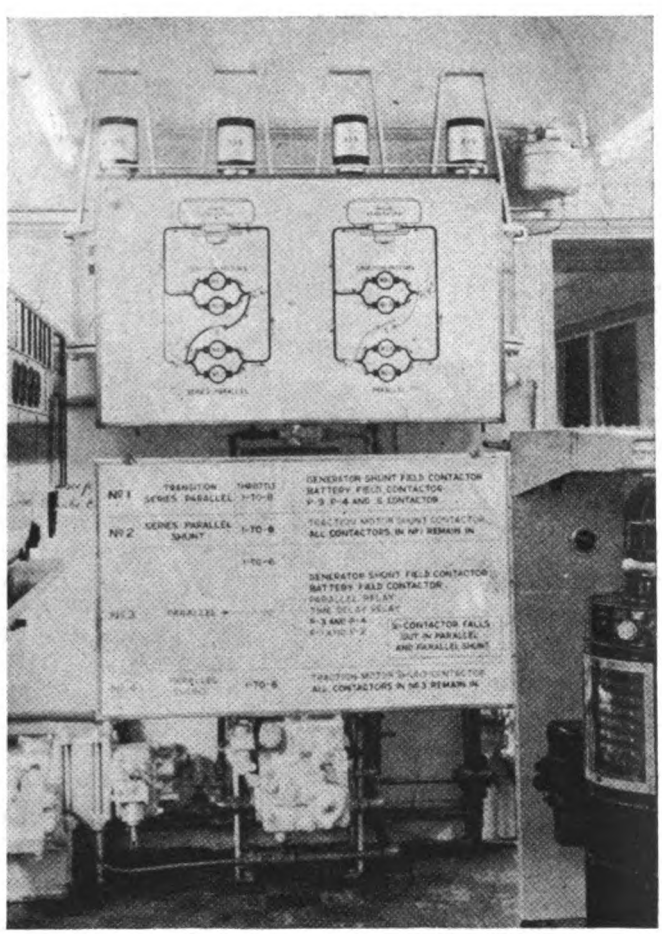
A four-cylinder section of an Electro-Motive 1,350-hp. engine has been installed in the car to demonstrate the action of the various engine parts. The right-hand side, showing two cylinders, is complete except that the top of the engine is cut away to show the operating appearance of the cylinder heads. On this same side the top of the housing has been cut away to show the action of the scavenger blower. On the left-hand side cutaways have been made to show the operation of the air separator, the gear train and the crankshaft. One cylinder head has been sectioned to show the operation of the valves. On the other cylinder on this side, the side wall and liner have been cut away to show piston action, the delivery of lubricating oil and the injection of the fuel oil through the injector nozzle. All of the cutaway sections are covered with sheets of clear plastic to prevent the possibility of accidents occurring by men getting parts of their bodies or clothing in contact with moving parts of the engine.

Plastic tubing is used for the water, lubricating-oil and fuel-oil lines so that their flow through the engine can be followed. An ingenious method of carrying trapped air bubbles in these various lines enables the flow to be followed readily. In addition, coloring matter has been added in all three systems which serves to identify the liquids flowing through the various pipe lines. All three liquids are recirculated by means of motor-driven pumps.

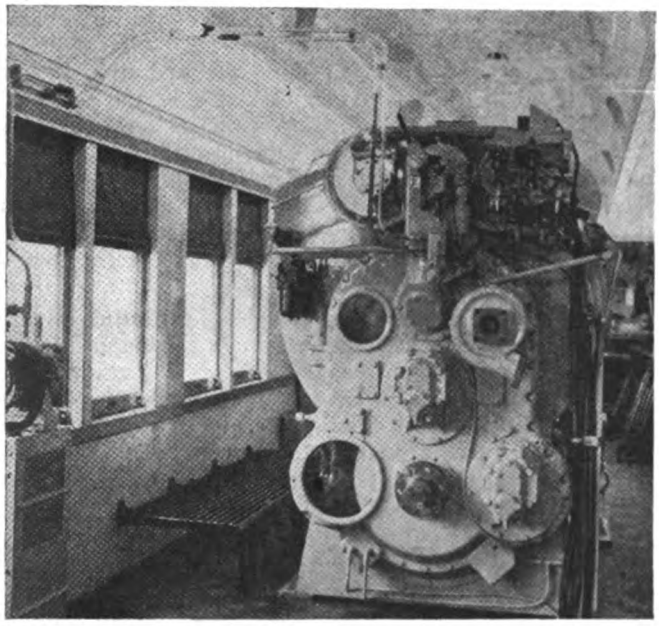
This engine section, which is complete with all gearing on both the front and rear ends, is operated from the engineman's control stand and permits explaining to operating personnel exactly what occurs within the engine in its working cycle. In addition it provides a means of familiarizing shop personnel with the various engine parts and their functions.

Electrical Equipment

The engine control and instrument panel, complete high and low voltage cabinets, and the distribution panel used on the 5,400-hp. freight Diesels are installed in the instruction car as nearly as possible as they appear in the engine



Charts are used to illustrate class lectures which are followed by actual demonstrations of operating matters discussed



Front end of four-cylinder engine section—Parts are exposed for study by the use of clear plastic cover plates—Lubricating oil, water and fuel oil flow through lines made of clear plastic tubing

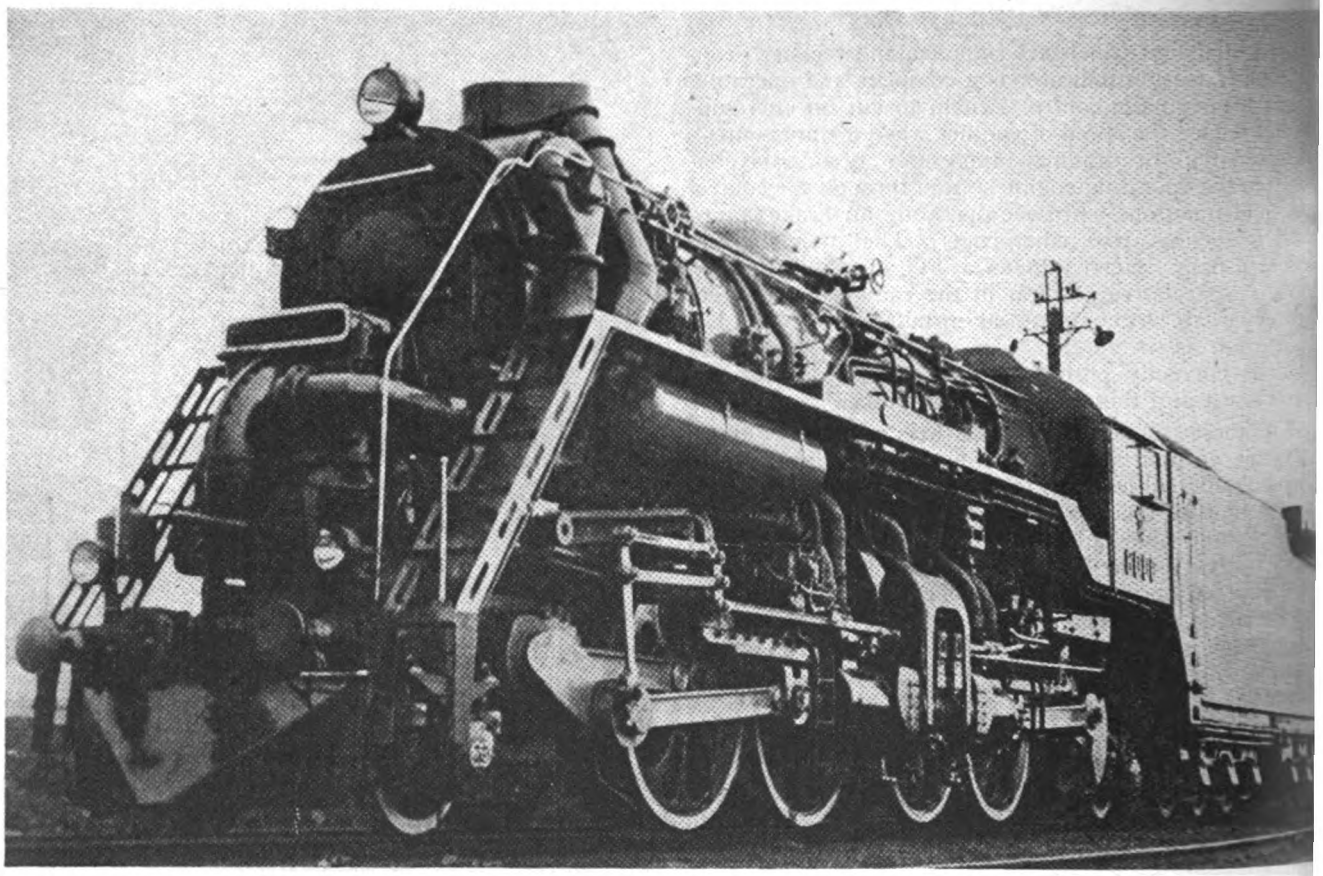
room on a locomotive. Space limitations make it impossible for them to be positioned exactly as they are with relation to the engine in a unit but as installed they operate in response to the regular engine controls. All switches, alarm lights, fuses and other parts of the electrical system are connected and function to protect the equipment in the instruction car as they do on a locomotive.

Other equipment in use on locomotives which is duplicated in the instruction car include a complete automatic train-control installation for 32-volt operation run from a motor-generator off the 64-volt current supplied by the Diesel locomotive batteries. These batteries are kept up by a gas-engine-driven generator which has been installed in the closed-off vestibule section at one end of the car. There is also a complete fuel-pump assembly with the fuel filter and an emergency fuel trip. Although the fuel trip actually is located beneath the cab on a locomotive it has been located in the car for instruction purposes.

The other major item of equipment which has been included in the operating exhibits in the car is a steam generator. Fuel and water tanks have been installed with this, which permit it to be operated during class sessions.

Models of gear trains and of a cylinder showing the operation of the fuel injector nozzle and valves are the most commonly used for instruction purposes. These with diagrammatic charts are used during the lectures delivered to class groups. However, with the size of class groups limited to about twelve men, formal lecturing is held to a minimum; actual demonstrations in which class members participate actively are to be relied upon as the best means of teaching men. The car is equipped with this idea in view and every effort has been made to provide a class room for training from which men can go to actual work and feel familiar with their surroundings.

* * *



Sovfoto

The first combined internal combustion and steam passenger locomotive in Soviet Russia—Built by the Voroshilovgrad Locomotive Plant
The steam cylinders of the locomotive are said to bring the speed up to 40 km. (24.8 miles) per hour before the internal-combustion engine is placed in gear—With both engines working together the speed of the loomotive is said to reach 120 km. (74.5 miles) per hour—Maizel, a Soviet engineer, is credited with the first suggestion of this combination of Diesel and steam power, the design of which was developed by the builder's engineers under the guidance of Pavel Soroka

Characteristics of

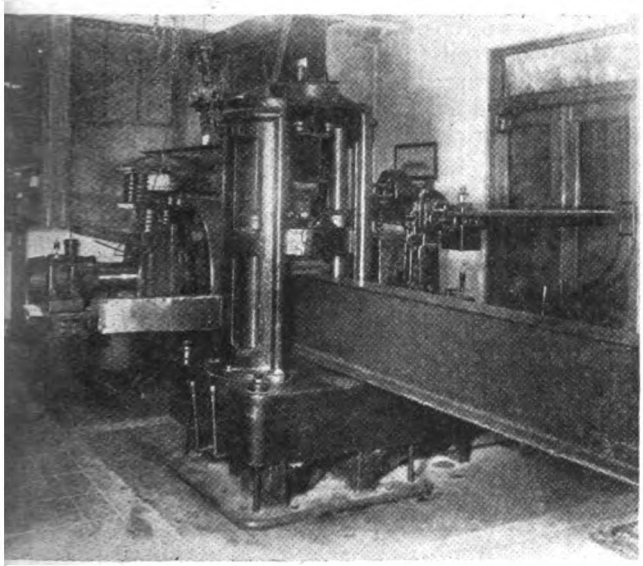
Car Journal Oil

By A. E. Hickel*

Both laboratory and service tests indicate that summer and winter black oils do not produce results possible with one all-season high-film-strength oil

RECENT discussions and investigations by the A. A. R. Lubrication Committee in regard to hot boxes will no doubt help to minimize these failures, provided everyone does his part (1) by using a high-grade scientifically-compounded oil; (2) proper and suitable waste, having the least short ends; (3) the correct amount of oil and proper facilities for saturating and preparing the waste; (4) by properly packing boxes; (5) by inspection at periodic intervals, and (6) by using mechanically correct bearings (brasses and journals).

If these six functions are performed by men especially trained for the work, the number of hot boxes will be greatly reduced. Where the oil is scientifically refined from the best cuts in the crude and properly compounded for high film-strength, low pour point, high flash and fire tests, high viscosity index and high capillary action, there will be little trouble as far as the oil is concerned and such an oil will give satisfactory and reliable performance during all seasons of the year.



Machine used in lubrication tests at the Sinclair Refining Company plant, East Chicago, Ind.

Extensive research tests were made a few years ago on such an oil, using a specially designed testing machine at the Sinclair Refining Company's plant, East Chicago, Ind. This machine included an 8-in. railroad journal shaft and a standard journal box. The oil cellar designed to fit the journal box required from 10 to 10½ lb. of prepared packing, i.e., 2½ lb. of dry waste and 7½ lb. of oil, this packing being prepared and used as in standard railroad practice. The speed of the machine could be varied up to 90 m.p.h. The load was applied by means of beams and springs using a Riehle machine. The coefficient of friction was obtained by calculating the pressure on a small platform scale. The coefficient of friction was comparative only because the two supporting main axle bearings (one on each end of the shaft) were not of the anti-friction or roller-bearing type and consequently are a trifle higher than if the anti-friction bearings were used. The temperature of the bearing (brass) was taken by means of a thermometer, which was within ¼ in. of the journal's center bearing, and a recording instrument thermocouple was set just below the thermometer well in the brass and within ⅛ in. of the journal itself.

The wattmeter readings were calculated for actual horsepower input. A blower was used to simulate road draft under locomotives or cars while in motion. Chart 1 shows the results plotted from tests made with two different all-season car oils. Run 39 with car oil No. 44 and Run 40 with car oil No. 45, were both made on standard A. A. R. babbitt. The average speed was held at 42½ m.p.h. constantly for 15 hr. without a stop. The bearing pressure was 500 lb. per sq. in. At the end of the run the machine was shut down overnight (8 hr.) and this same test was again duplicated the second day for 15 hr. at the same speed and pressure.

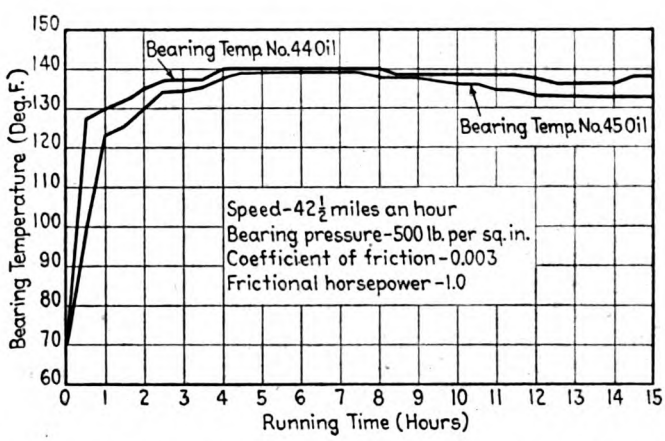


Fig. 1—Comparative test results with two all-season car oils on an A.A.R. babbitt-lined brass

The highest bearing temperature of oil No. 44, as plotted in Fig. 1, was 140.8 deg. F., and the bearing temperature rise was 70 deg. F. The highest bearing temperature of oil No. 45 was 136.1 deg. F. and the bearing temperature rise was 69.1 deg. F. The average coefficient of friction for both days on both oils was .003 and the average frictional horsepower was 10.

Field tests in actual service, made with an all-season

* Consulting lubricating engineer, Chicago.

high-film-strength oil on a northern railroad at 50 deg. F. below zero, were very satisfactory. At no time was waste packing pulled out and the lubrication at this subzero temperature was good. According to this test, no cut-back oil seems necessary if the right oil is used originally. Tests

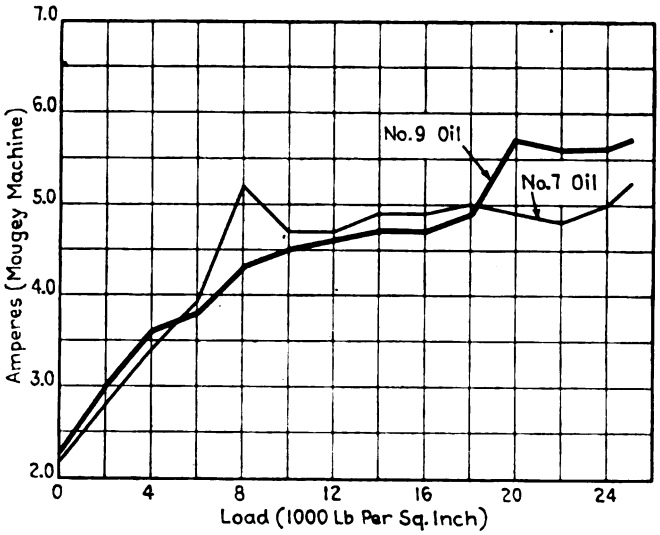


Fig. 2—Film-strength tests up to 25,000 lb. per sq. in. with two all-season car oils

made in hot climates showed remarkable results with such an extreme-pressure all-season car oil.

The oil most suitable for the average waste now in use by the railroads is a low-viscosity oil, having a low pour point, high film strength and a high vis index. The minimum viscosity should not be lower than 45 sec. at 210 deg. F. and, on a high film-strength oil, not less than 38 sec. at 210 deg. F. The oiliness or adhesion test rating should not be lower than 10 per cent at a temperature of 220 deg. F., although a high-film-strength (extreme-pressure) oil will show a rating of about 36 to 40 per cent adhesion at this temperature.

The film-strength test, as shown in Fig. 2, made on the Moughey machine on two extreme-pressure car oils was 25,000 lb. per sq. in. for each oil, as against an ordinary oil of 7,000 to 8,000 lb. per sq. in. The load-carrying performance of a high-vis-index oil is much greater at 250-260 deg. F. than an oil having a low-vis index, which indicates greater oiliness and adhesion, as well as less change in viscosity at these high temperatures, but there also must be a low rate of change in the adhesive property (affinity to metals) with temperature.

A suitable car oil must have high capillary action as shown in Fig. 3. This test was made by using a glass cylinder graduated in cubic centimeters and a ½-in. diameter glass tube of the same length, also marked off into cubic centimeters and attached to the cylinder with a rubber band.

The glass cylinder is filled with 30 cu. cm. of oil at room temperature and a four-strand worsted wool yarn about 5 in. long is inserted and immersed completely in the oil. When well soaked, the wool yarn is partially raised out of the oil and drained somewhat, an inch of one end being inserted in the top of the glass tube and four inches remaining in the cylinder. Feeding of the oil, due to capillary action, takes place at once and readings are taken every 15 min. during the first hour and every hour thereafter for 6 hr. The cubic centimeters of oil lifted over are plotted, as in Fig. 3; however, it is best to let the test continue overnight, so as to observe the total possible amount of oil lifted over in 24 hr. at the same room temperature. The total lift in inches in 24 hr. was measured and plotted and amounted to 1⅜ in. for oil No. 1, 1½ in. for oil No. 2, and 1⅝ in. for the No. 7 oil.

The oil having the highest capillary test would feed the best in actual service, provided all other factors, such as high film strength, oiliness, etc., are tested before hand and the oil meets the standard specifications otherwise.

The capillary test disproves the contention of some, that a thin oil will stay in the bottom of the box, or claims of others that it will work out too much in the back of the box. During the laboratory machine tests, it was observed that a bead of oil formed on the on-side of the brass which extended clear across the length of the brass. This excess oil, carried there by the high capillary action of the oil, assured a complete oil film on the journal bearing at all times and was held there by the rotation of the axle, and no loss of oil was noticeable.

By using a low-viscosity oil, as described, no doubt there would be a trifle larger consumption, although such was not the case in the laboratory tests. Granting that the oil consumption is somewhat more during the summer months, it still would be cheaper than hot boxes, delays and expensive repairs.

Most black oils are not suitable for all-year service, especially during the cold weather, as the oil congeals, gets sticky and has a tendency to pick up loose and small ends of the packing material, which accumulate at the edge of the brass and work underneath, causing waste grabs.

The used waste must be cleaned and free from short pieces before it can be used again. Reclaimed oil must be watched and tested before it is again used. The boxes should not be packed so tight that glazing takes place.

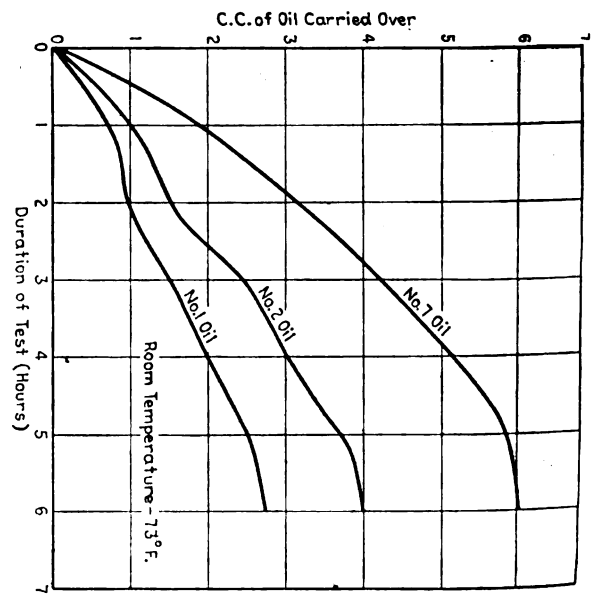


Fig. 3—Cubic centimeters of oil carried over by capillarity in test of three all-season oils

This glazing may occur even with a light or low-viscosity oil. The heavier black oils, of course, cause glazing much more easily.

An oil with high capillary action will feed to the top of the waste in any climate and sufficiently wet the journal bearing for proper lubrication. Railroads will have hot box trouble as long as all roads do not use approximately the same oil specifications and better yet, use the same oil. If some use a cheap black oil and others a high-grade oil, the oil will eventually be mixed, as cars are serviced all over the country, with the attendant probability of lubrication failures.

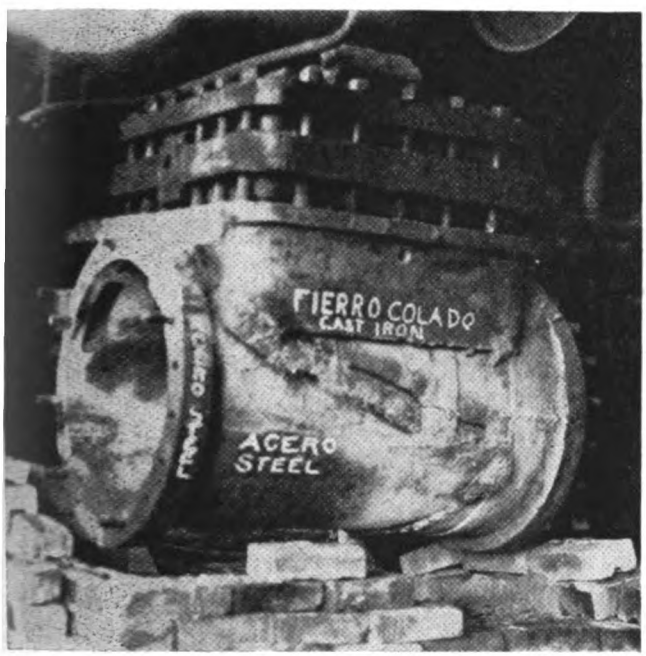
Welding On

Mexican Railways

By J. W. Boyd*

Material shortages overcome by the extensive use of welding repair and reclamation—Lack of any limiting regulations allowed wide range of applications — Mexicans are skillful operators and the results have been good

Few realize the size of the vast, mountainous territory served by the National Railways of Mexico. Considering the line alone, from the Guatamala border to the United States border at El Paso, Tex., the distance is 2,580 railroad miles and, with its many branches linking the east and west coasts, it is indeed an immense system. Most of the railroad runs through mountainous territory and is consequently difficult for railroad operation, requiring constant maintenance of both rolling stock and track.



Oxyacetylene bronze welding was used to join a rolled steel replacement section in the cast-iron cylinder

In the reclamation of material and reconstruction of locomotives and cars by the use of autogenous welding, it was necessary to perform work that would not be permitted under the regulations of the railroads in the United States. Without government regulations controlling the quality of material used and the limits of application, it was possible to extend the work in Mexico into fields prohibited in the United States. A sudden increase in freight to be moved created an emergency which had to be met with emergency measures.

It would be difficult to name any part of a locomotive or car, no matter how important, that has not been reclaimed by welding during this time, and with surprisingly good results. The railroads were not in a position to say that it could not be done. Locomotives and cars had to be moved to carry strategic materials essential in the manufacture of war materials to their destination.

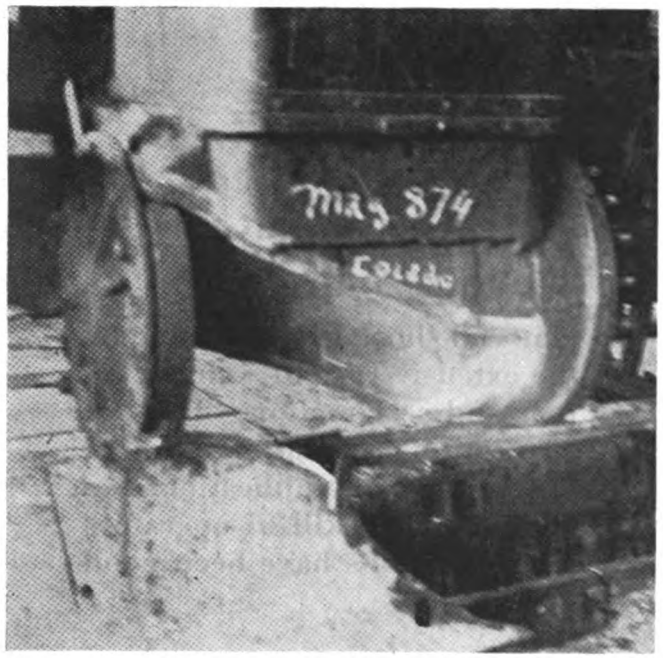
There was no choice to be made in selecting the material for any particular job. It was necessary to use whatever the war effort could release to this country, and there were long delays due to priorities and material shortages in obtaining all materials. Old and obsolete welding and cutting equipment was renovated and returned to service and, in some cases, was redesigned to fit the supplies that were available.

One of the largest shops on the system, employing 35 cutting torch operators, was using five different makes of cutting torches, manufactured in as many different countries. Cutting nozzles and repair parts were almost impossible to get. To prevent a complete standstill, the nozzle that was the easiest to obtain was chosen as standard and new torch heads were made to suit the nozzle. Some of the equipment manufacturers would be surprised to see Swiss, Swedish or German made equipment sprouting torch heads of a United States design. This and many other ingenious practices were used to continue maintenance of motive power and equipment.

Before the war a large percentage of the electrodes used for arc welding was purchased in the United States, as the manufacture of this material in Mexico was inade-

Fabricated section made from boiler plate being fitted to replace missing part of cast-iron cylinder barrel

* Welding technician, United States Railway Mission in Mexico, Mexico City.



A broken cast-iron locomotive cylinder being prepared for welding with the steel ring for the front face shown in position

quate and in its infancy. However, when the increased demand for the proper material put them entirely on their own resources, the quality of this material improved rapidly. Specifications were set up by the National Railways of Mexico for welding material, forcing the local manufacturers to improve their products. At present, welding electrodes can be purchased in Mexico that meet all of of the specifications of the American Welding Society and the Association of American Railroads. This was not only a great help to the war effort, but has also put Mexico on an even footing with similar industries in other countries.

The Mexican mechanic is very skillful, and the personnel in general is congenial and always eager to improve its knowledge and grasp new and improved practices. Difficult welding operations are performed frequently, and, in some cases, under unfavorable conditions.

The illustrations give an idea as to what has been accomplished here when new material could not be secured. They show a broken locomotive cylinder that was reclaimed and has since been in service for over two years. The large section of cylinder shown missing, could not be found and a new cylinder was not available. Restoring this locomotive to service meant additional power to move rolling stock when locomotives were scarce.

The cylinder was made of cast iron and, as the missing piece could not be replaced, a fabricated steel section was substituted for the cast iron. The front face of the cylinder was formed from a piece of mild steel which is shown held in place by the cylinder head. The missing part of the barrel was formed from boiler plate and welded to the front face by the arc-welding process. The entire new steel section was then joined to the cast-iron cylinder, using the oxyacetylene bronze welding process. When the entire operation was completed, the cylinder contained four different kinds of metal: cast iron, steel, electric arc weld metal and bronze deposit. Although the cylinder was not removed from the locomotive, it was confined in a specially prepared furnace and carefully preheated before welding and stress relieved after welding.

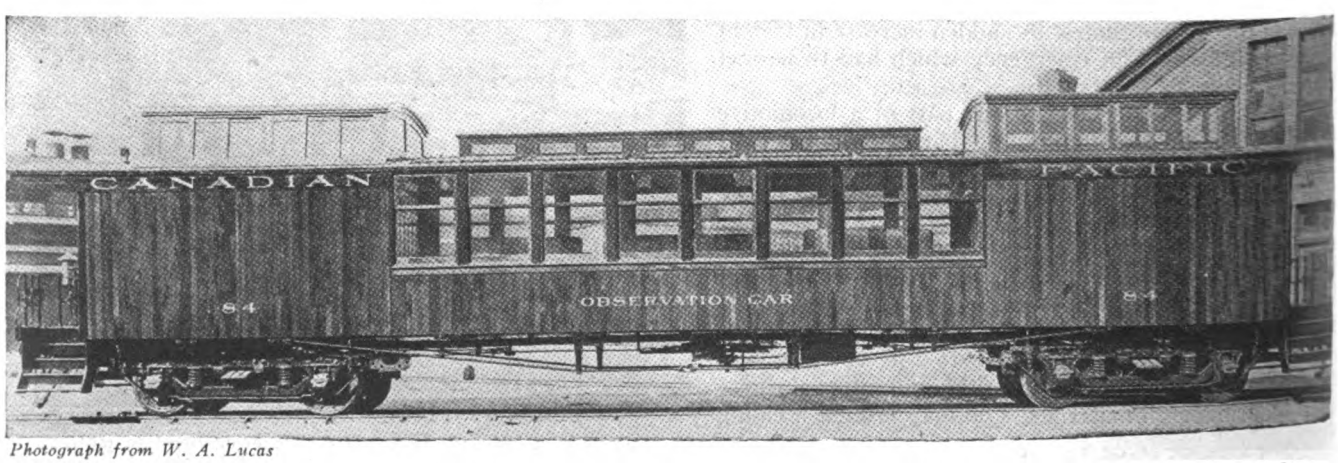
These new sections of steel were so skillfully made and set in place by a Mexican mechanic, that less than $\frac{1}{16}$ in. of metal was removed when the cylinder was rebored. The locomotive was out of service only six days, whereas, had a new cylinder been applied, the time out of service would have amounted to at least twenty days, including the machining and delay in transportation. The work was done in May, 1943, and, as the locomotive has now been in service over two years, the savings in cost of a new cylinder can also be considered.

Similar welding operations are performed daily and it is safe to say that close to one hundred locomotive cylinders alone have been reclaimed in the various shops spread over the Republic of Mexico. These, together with the many locomotive and car parts that have been reclaimed and restored to service, have been largely responsible for keeping the railroad operating during these years of metal shortage.

In the maintenance of way department, miles of track have been reconditioned by building up battered joints by the oxyacetylene welding process. Deep-well pump shafts of 500 ft. in depth have also been reclaimed in this department by welding. Some of these practices are not recommended but necessity called for special effort and the emergency has been met successfully by the Mexican National Lines.

It would be well to mention that most of the members of the United States Railway Mission, that have been in Mexico, will carry back to the States with them, many new and improved practices in railroad maintenance that will assist in improving conditions at home.

* * *



Photograph from W. A. Lucas

This double-cupola observation car was used on the Canadian Pacific about 35 years ago

EDITORIALS

Small Shops— And New Tools

Recently, on a visit to a small railroad shop located on a road with about 75 locomotives, a discussion took place among some supervisors as to the justification for investment in new, and to them somewhat expensive, machine tools. This shop has about $300,000 worth of machinery, at book value, in the machine shop and has a machine shop labor bill of around $80,000 a year on the basis of single-shift full-time operation.

One supervisor took the position, in discussing a new machine recently installed at a cost of $20,000, that is was necessary to save from two to three thousand dollars a year in order to justify the purchase of the machine and that this same amount of money would hire another man which in his estimation was worth more to the shop than a machine that might be used only four to six hours a day.

Here, without going too deeply analytical, is a practical question—the question of the value of a man or a machine.

This new machine is of a type that is suited to the production of more than 200 different locomotive and car parts and yet, after being in service for 30 days it was producing only about two dozen of the potential 200 because the new machine produced these two dozen different parts much faster and with infinitely greater accuracy than any of the old machines in the shop could have done, and was kept busy full time on work transferred from other machines in the shop. Here are two reasons why the savings effected by a new machine can be said to be more valuable than the same amount of money spent for additional labor. The extra man, working on an old machine would not make the same parts as fast and could not make them as accurately.

The new machine, as the months of its service go on and the operator and foremen get more familiar with it, will produce more and more of the potential 200 different parts until, at some future date, the shop accountant will find that the economies have not only paid for the new machine but that the transfer of work from the old machines have made it possible to retire several obsolete machines. Had the money been spent for labor it would merely have been expended and, at the end of the same number of years, the old machines upon which the labor was used would be that much older, that much more inaccurate and, in the end, the new machine would have to be installed.

Postponing the purchase of new equipment which has greater potentialities, of whatever nature, than old machines now in their shop is merely a sure way of throwing away money in the perpetuation of obsolete machines which, with any kind or amount of labor, can never do the work that modern equipment can do.

Depression Thinking

During the lean years for the railroads before the war it was not uncommon to find that the size of mechanical-department forces, or at least the money made available to pay for labor on mechanical work, followed a curve which was roughly comparable to the carloading figures. This was not true on all roads but on quite a number it was a fact that mechanical-department heads could almost gauge the amount of money which would be set up in their monthly budgets but a survey of carloading figures for the several weeks preceding budget meetings. However necessary this may have been it certainly did not encourage programming of work in the most efficient manner—if carloadings went up unexpectedly there was a windfall for the mechanical department and work—any work—was scheduled in order to spend the unlooked-for riches; if, on the other hand, carloadings dropped below what had been anticipated even the minimum scheduling which was attempted was seriously interfered with. Work stood incompleted in the shops until another favorable turn in the carloadings permitted it to be resumed. Schedules were nothing more than guesses of what work might be accomplished subject to revisions which were almost certain to occur.

Whether this idea that dollars, almost literally, had to be collected in freight revenues before they could be spent on maintenance or repair work was justified by circumstances is questionable. Certainly it was not economical, no matter how adequately it served to keep monthly accounting figures in relative balance. The inability to schedule work with any certainty that it could be completed according to schedule was a wasteful handicap to mechanical-department officers. Properly scheduled repair work permits every workman sufficient uninterrupted time at each job for it to be completed in the most efficient manner. A locomotive on a backshop pit that looks like an ant hill because of the number of men clambering over it and working around it to get it finished before a reduced budget goes into effect is not being repaired at minimum labor costs.

Great strides have been made in organizing various

shop operations through machine relocations, improved material handling and work-flow studies. Where these changes have been made their value in increased output and reduced unit costs have proved them to be worthwhile. The value of such work, however, is related closely to having a total shop load which permits maximum efficiency in utilizing facilities available. This calls for planning and planning is not possible on a hand-to-mouth basis. Monthly budgeting may still be necessary, but it should be monthly budgeting on an overall program which permits at least a minimum of scheduled repair work to be planned for and carried through to completion.

With the war strain removed there will be an increasing tendency to return to doing things as they were done in the years before the war. Immediately after V-J day caused a reduction in total carloadings, it is understood that as in the past, orders went out on a number of railroads to reduce mechanical-department forces. It seems that wide-awake mechanical officers should fight this trend, if it is a trend, back to depression thinking. Carloadings and the labor force are not directly related, work requirements and needed labor for its accomplishment are closely related. Efficiency in shop operation, minimum unit repair costs and maximum mechanical performance of cars and locomotives will be vital factors in the coming battle for transportation revenues. Maintaining them will require intelligent planning and, perhaps, a fight for the right to achieve them.

Good Lubrication Vitally Important

No truer statement was ever made than that the industrial development of any nation is limited by the amount and quality of lubricants it can obtain to keep machinery moving. In fact, one of the most potent reasons for the defeat of Germany in the war just ended was undoubtedly the effective action of the allied nations in disrupting not only the supply of gasoline but lubricants essential to Germany's massive war machine.

Railroads also cannot run without proper lubricants and lubrication and, particularly at the present time when the load on motive power and car equipment is still being sustained at near maximum levels, equipment failures on the road can be minimized only by constant intensive efforts to improve lubrication conditions. Consider the variety of lubricants required on a steam locomotive alone which include steam valve and cylinder oils, driving journal compounds, crankpin lubricants, pressure gun lubricants for valve-motion parts, roller-bearing greases and oils, air-pump lubricants, car and engine oils, hub-plate and shoe-and-wedge lubricants, flange oils, headlight generator lubricants, feedwater-pump oils, etc. A tremendous amount of research in the aggregate, on the part of both oil companies and the railroads, has entered into the development of satisfactory lubricants for this wide variety of uses.

Locomotive valve and cylinder oils have been developed to stand progressively higher steam temperatures and piston speeds and railway experience and good judgment of the highest order are required in specifying the kind and quantity of valve oil necessary for best results in the various classes of locomotive service. Similar effective consideration must be given to the question of driving-journal compounds which normally have to lubricate satisfactorily at temperatures from zero or lower to 250 deg. F., or even higher when crown brass pinching, tight wedges, improper weight distribution or other mechanical causes tend to result in hot boxes. Crank pin greases, pressure-gun lubricantion and roller bearing lubricants also require specialized attention and the best co-operative effort of experts in both the oil and railroad fields if lubrication failures are to be avoided in locomotive and car equipment.

As one typical detail, take the question of brake-cylinder lubrication, in which the lubricant is required to prevent wear of metal parts, preserve packing cups for a substantial period of time and seal the cylinders against air leakage in brake application. This lubricant must be of such a character that it will not be washed away by moisture condensed when the compressed air cools. Moreover, the improved lubricant now recommended for use in brake cylinders is not only water-insoluble and designed to promote increased packing-cup life but, owing to elimination of a slight amount of water formerly used as a bond, has a higher melting point and increased stability of the grease under relatively high temperatures, such as often developed in locomotive brake cylinders due to their location. The amount of research which oil companies and air-brake manufacturers have put into developing satisfactory air-brake lubricants, alone, is very large and railroads will "miss a bet" if they fail to take full advantage of the research and experience of these joint industries.

These facts and numerous others bearing on railway lubrication problems were presented in a comprehensive discussion of the subject by A. D. Pendergast of the Texas Oil Company at the April meeting of the Northwest Locomotive Association. Railway equipment, including all types of locomotives, freight cars and passenger cars, is now being used with an intensity which has placed exacting requirements on both railway man-power and equipment. Less time out for repairs, quicker dispatchments and shorter turn-around times are required. This means that repair work and servicing must be minimized which can be assured only by effective lubrication, the specification of lubricants especially prepared for railway service and the use of proper methods, tools and equipment in the application of these lubricants.

Steam-Locomotive Evolution Continues

The past 20 years have been a period of intensive development of the steam locomotive on the New York Central. The tangible steps began with the 4-6-4 type locomotive design, known as Class J-1, which culminated in the design of the Class J-3, first built in 1938. Then came a period of improvement in the 4-8-2 type, long the principal type of New York Central freight locomotives. The L-4 class, which to date is the last word in this phase of the development, is an effective passenger locomotive as well as a freight locomotive. On another page in this issue another step in this development is described. This is the Class S-1a locomotive, a 4-8-4 type.

Something of the objectives and accomplishments of these two decades of development on this railroad are indicated by the comparison of the J-3, the L-4 and the S-1a classes, each of which represents the present status of its type. The Class J-3 locomotive develops a maximum indicated horsepower of just under 4,800; the Class L-4, 5,470. The S-1a, pending tests, is expected to deliver a maximum of 6,000 i.hp. This represents a horsepower output per driving axle of 1,500. This is not much different from the 1,576 hp. per axle of the J-3 class, but is a much more intensive output than the L-4 class at 1,368 hp. per driving axle.

The Class S-1a estimated boiler performance exceeds that of both the other two locomotives. These each have approximately the same ratio of firebox heating surface to total evaporative heating surface (0.086 for the J-3 class and 0.080 for the L-4 class). The total evaporation of the Class J-3 was 96,000 lb. and the Class L-4 103,000 lb. Thus each developed a fraction over 22 lb. of evaporation per square foot of evaporative heating surface. The new boiler is expected to evaporate up to 125,000 lb. and if it does, it will be at the rate of 27 lb. per square foot of evaporative heating surface. This expectation is, no doubt, based largely on the change in ratio of firebox heating surface to total evaporative heating surface, which has been increased to 0.112.

There is little variation in weight efficiency among the three types. The pounds of engine weight per indicated horsepower are, respectively, 76.2 for the Class J-3, 72.5 for the Class L-4, and 78.5 for the Class S-1a. In the matter of counterbalance, however, none of the three locomotives are alike. While the reciprocating parts of the L-4 and the S-1a are approximately the same, the overbalance on the S-1a locomotive has been brought down to 387 lb.—97 lb. per wheel. For the L-4 and J-3 locomotives, respectively, the overbalance is 543 lb. and 493 lb., which is equivalent to about 136 lb. and 164 lb. per driving wheel, respectively. The weight of the unbalanced reciprocating parts per ton of locomotive is 3.34 for the J-3 locomotive and about 5 lb. for each of the two eight-coupled locomotives. The counterbalancing of all of these locomotives is well within the limits for satisfactory performance suggested by the report of the A. A. R. Counterbalance Test for Locomotives for High-Speed Service.

Traction Gear Maintenance

Two reasons for Diesel traction motor failures were offered in the September issue of *Railway Mechanical Engineer* in an editorial entitled "Temperature or Vibration?" It is the contention of some operators that unequal heating of coils and core causes coils to move longitudinally in the slots causing the breakage of end turns and the appearance of a ring of powdered mica around the armature near the ends of the coil slots on the pinion end.

A second explanation for this condition, is that it is caused by high frequency vibration. It is said that gear and pinion teeth slide as they come into mesh, rock or roll as they pass center position and slide again as they part company, leaving a high spot at the center of the tooth contour. This condition, it is contended sets up vibration of twice the tooth frequency which is detrimental to electrical insulation.

The experience of at least one road denies this theory. It has been found that pinion and gear teeth wear most at the center, half way between the tip and the root, and that when this wear exceeds 25 or 30 thousandths of an inch the tips of following pinion and gear teeth will strike upon coming into mesh causing excessive vibration or broken teeth. One method used to avoid this circumstance, is to regrind the contour of the pinion and gear teeth before the wear reaches a dangerous amount. The grinding restores the original curvature of the tooth surface and also removes the shoulder which is formed near the root of the tooth as the tooth wears. Two railroads are now doing contour grinding.

Others contend that gears and pinions should be matched, that a gear and pinion should be kept together throughout their life. This they say will avoid trouble. This the gear grinders say is obviously bad practice since bearings and bearing fits wear, and when they are restored, any "matched" pinions and gears will no longer match and gear teeth will strike shoulders worn in pinion teeth.

Still others say it is the pinions which suffer the most wear and if they are changed out often enough there will be no gear-pinion problem. It is their contention that the price of replacement is less than the cost of restoration.

Whatever the solution may be, it is a problem which calls for the meeting of minds and a comparison of experiences since broken pinions or gears means locomotive failures and expensive maintenance operations. The subject seems to suggest itself as something for the consideration of a railroad association committee.

IN THE BACK SHOP AND ENGINEHOUSE

Streamline Railroad Shop Layout

By H. H. Jones

Part of the postwar program of planning for the railroads, with the keen competition they will face from the air, the highways and the waterways, should be "streamlining their shop layouts" and doing all they can to secure increased production with minimum costs. High wage scales are here to stay, and the only way the railroads can stay out of the red in the postwar days is to install the very best and the most efficient equipment and facilities that are available. In addition to the purchase and installation of the best equipment obtainable, they should also pay more attention to the proper location and installation of such equipment.

The photograph shows just how streamlining railroad shop layouts can be done, and with very little cost. The illustration shows two typical railroad shop groups or departments, namely: the crosshead group and the piston group. The proper machines and other equipment were selected and arranged in the proper locations to give improved production. The same procedure can be followed in all the other departments, and much backtracking can be eliminated, as well as the unnecessary handling of materials. Work flows in the direction the arrows point.

Another feature of this type of layout is the material zones indicated by the wording "put material here." With this arrangement, it is not necessary to pile work around the machines. This is also a safety feature and helps to keep the shop clean and orderly. Two walkways and drive-ways with connecting passages are provided. The space around all machines is clear of material and racks for storing the material have been provided.

In making layouts of this kind, the location of the machines can be changed until the desired layout has been secured and then the entire layout can be photographed and as many copies made as needed, the scale used is ¼ inch to one foot. The templates are made of soft pine or other material ¼ inch thick. These layouts can be used to stress the importance of the selection of the right kind of machine tools for doing the work in each of the departments. The proper location of machine tools in any shop is of the utmost importance and should receive much more attention than it has in the past.

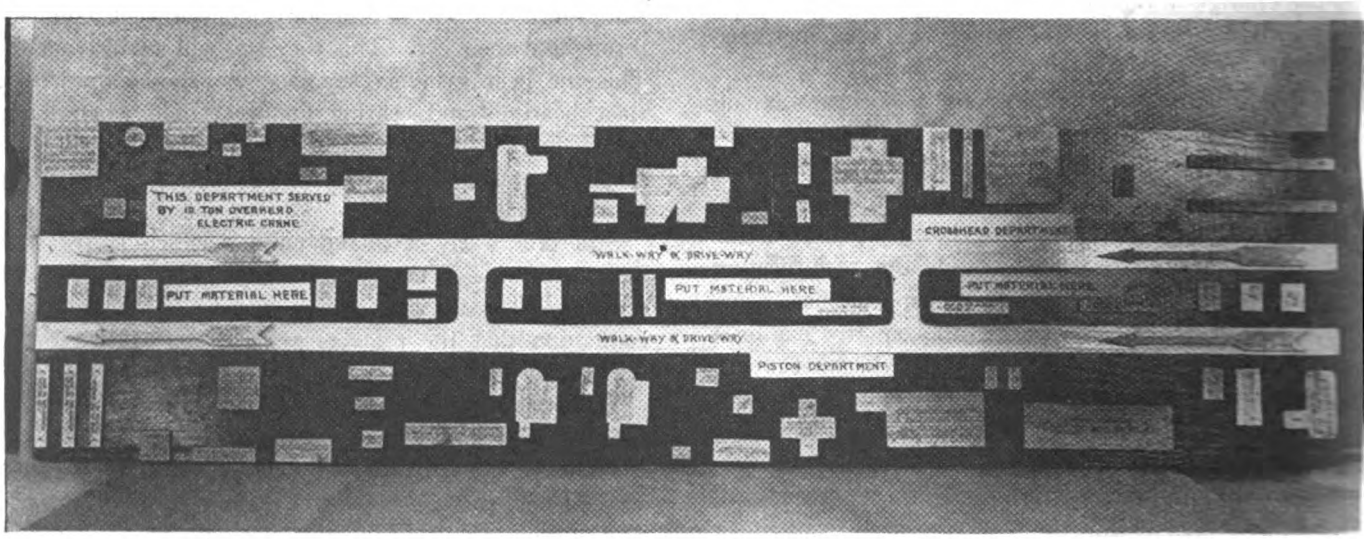
Removing Draft Gears And Couplers on a Pit Track

A device used for removing couplers and draft gears from Diesel-electric locomotives undergoing repairs at the Wayne Junction electric shop of the Reading has reduced the length of time required for the operation and eliminated the need for using overhead crane facilities in the shop. The saving in crane time was especially important in this busy shop where the railroad's multiple-unit suburban equipment is also maintained and repaired.

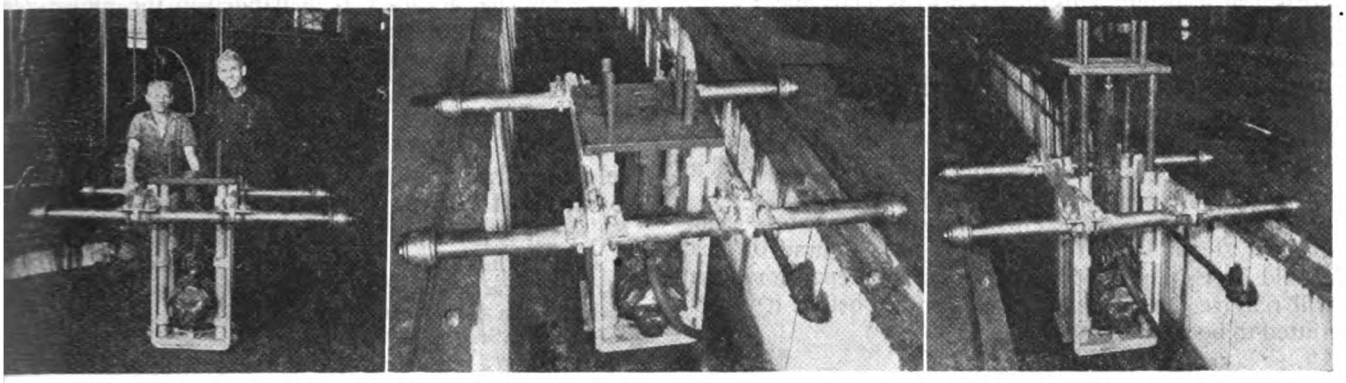
The device consists of a yoke built to house an air-motor-operated standard jack on a bed plate in the yoke. A plate to support a coupler or draft gear is fastened to the end of the ram of the jack. Guide rods on the corners of the plate run up or down in pipe sections which are welded to the side members of the supporting yoke. Pins dropped in holes drilled through the table plate prevent side movement of a coupler or draft gear on the plate.

The supporting yoke is mounted on two axles with wheels attached and is moved on the regular track rails.

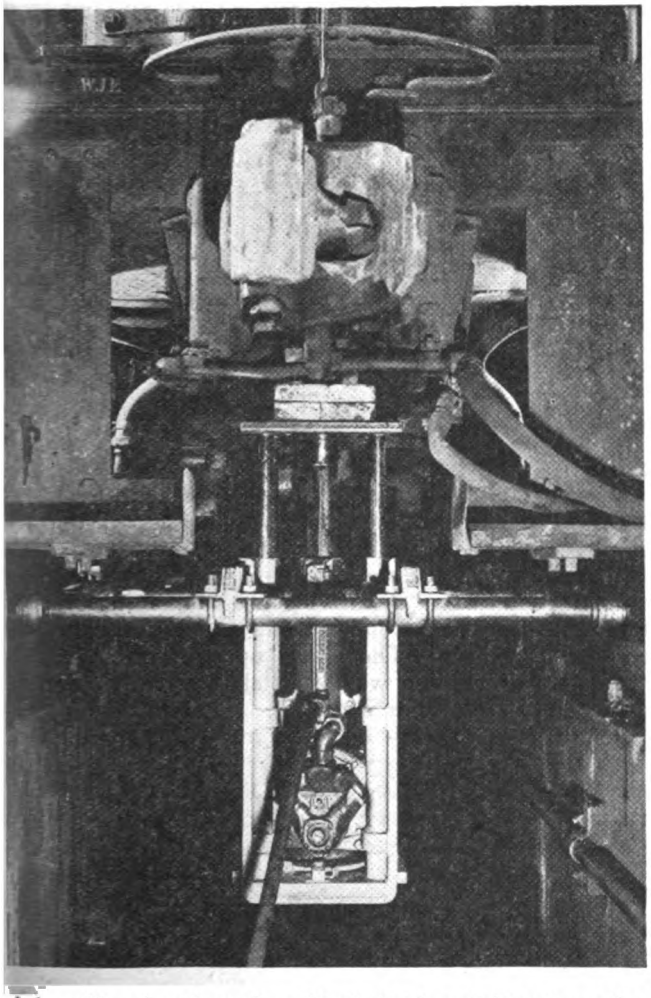
Motor-driven, vertical-spindle, cup-type grinding wheels, mounted on planer tool heads, have been used for this purpose, but a more powerful grinder application with horizontal spindle, as shown in one of the illustrations, has been developed and successfully used at the Decatur shops of the Wabash. This grinding attachment is applied to one of the tool heads of an 84-in. Niles planer. The 20-in. by 2¼-in. face grinding wheel is mounted on a 3-in. horizontal spindle 32 in. long, supported in roller bearings with the housing bolted to a vertical plate, 1 in. thick by 15 in. wide by 34 in. high, which



A layout board used in deciding upon the most efficient work-flow arrangement of shop departments



Left: Machinist John Woffenden and Blacksmith John Aicher with the draft gear removing device which they developed for the Reading—Center: The device ready to be moved under a locomotive—Right: The device with the ram extended showing the table guide rods



Jack positioned underneath a Diesel-electric switching locomotive for the removal of the coupler and draft gear assembly

carries a 10-hp. induction motor at the top and is itself bolted to the cross-rail head by means of two 1⅛-in. studs and a bolt through the swivel on the clapper box.

The motor and spindle center lines are spaced 18 in. apart and power is supplied from the motor to the grinding wheel spindle by multiple V-belt drive. Slack in the belt drive is taken up by adjusting the motor position by means of slotted holes in the supporting plate. The motor speed is 1,200 r.p.m. and the use of a 5-in. upper pulley and a 7-in. lower pulley gives a grinding wheel speed of approximately 860 r.p.m.

This grinding attachment is powerful, smooth and accurate in truing the worn pedestal ways of roller-bearing locomotive boxes and, of course, can also be used for many other grinding operations. Dependent upon the amount of box wear, a pair of roller bearing boxes can have the pedestal ways trued with this grinding attachment in about 8 hr. When not in use, a bracket on top of the grinder permits lifting it with the shop crane and attaching it to a bracket bolted to the side of the planer frame where it is stored in an upright position, out of the way and not subject to damage.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Matching Rivet Holes

Q.—How are the spaces between the rivet rows determined when laying out the welt strips for a longitudinal seam, so that they will match up with the rivet holes in the shell course?—R. K.

A.—The general practice is to lay out a full-size cross section of the seam and scale the spaces between the rivet holes on the neutral diameter of the inside and outside welt strip. These dimensions can also be derived by the use of the proportional method as follows:

$$R : A = R' : X$$

then

$$X = \frac{R' \times A}{R}$$

where

R = neutral radius of shell.
R′ = neutral radius of welt strip.
A = space between longitudinal rivet rows (shell).
X = space between longitudinal rivet rows (welt).

Oil in Boiler Water

Q.—What effects does lubricating oil found in exhaust steam that is returned to the boiler, as condensate from the feedwater heater, have on the boiler?—F. M. P.

A.—Lubricating oil in the exhaust steam, when condensed and returned to the boiler, will coat the heating surface of the boiler with an insulating film which re-

tards heat transfer. This oil acts also as a coagulent which unites the finely divided solid material in the boiler water and creates a plastic film that adheres to the heating surfaces. The insulating effect of oil and oily deposits may cause overheating and subsequent failure of tubes and firebox side sheets. The presence of oil in the boiler is always a source of possible injury to the boiler, as well as the cause of a loss of boiler efficiency and capacity.

A locomotive equipped with feedwater heaters using exhaust steam from the cylinders as a course of heat should be equipped with condensate oil separators, that will remove the oil from the condensate before it is permitted to be returned to the boiler.

Overcoming Warping In Flame Cutting of Plate

Q.—When fabricating feedwater pump brackets out of ¾-in. steel plate, using a flame cutting machine to cut the plates, we are experiencing trouble with the plate warping and buckling. How can this warping be overcome or prevented?—M. I. K.

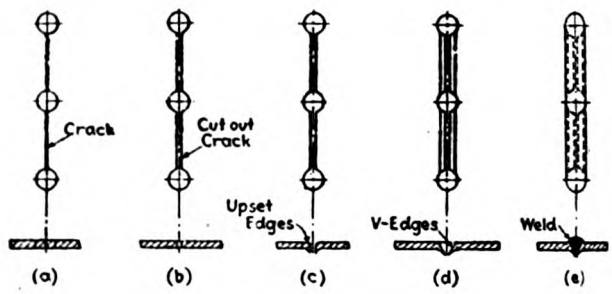
A.—The plate should be held rigidly in line by clamping it to a bedplate or other rigid member that will resist expansion and contraction movements of the material. If the plate or part cannot be held rigidly during the cutting operation, the effect of expansion and contraction can be nullified almost completely by making two or more cuts simultaneously or in rapid succession about the neutral axis of the member. This tends to equalize the forces set up and to neutralize their effect.

Plate under ⅜ in. or over ¾ in. in thickness are seldom warped or buckled perceptibly by flame cutting unless they are long and narrow. For splitting long narrow plates or pieces the method of skip-cutting is occasionally employed. In this application the cut is made to skip at intervals depending largely on the character of the work, which leaves a series of uncut sections along the line of the cut edge which are about 1 in. long. These uncut sections hold the material in line until it is cooled. They are cut through then to separate the parts. Quenching the cut progressively also has been used effectively on long narrow sections. The same effect can be gained by making several simultaneous cuts with two or more torches or blowpipes, which are moved together along parallel lines. Where unusual accuracy is demanded in the dimensions of flame cut parts, correction factors must be applied in making the cutting layout, particularly if the plate or part is preheated.

Welding Cracks At Staybolt Holes

Q.—What is the best procedure for welding a cracked firebox side sheet? The crack is on both sides of the staybolt hole, with one of the cracks extending to the adjacent staybolt. Should the entire area be cut out and a patch welded in place or is it satisfactory to vee out and weld the cracks without a patch? —M. I. K.

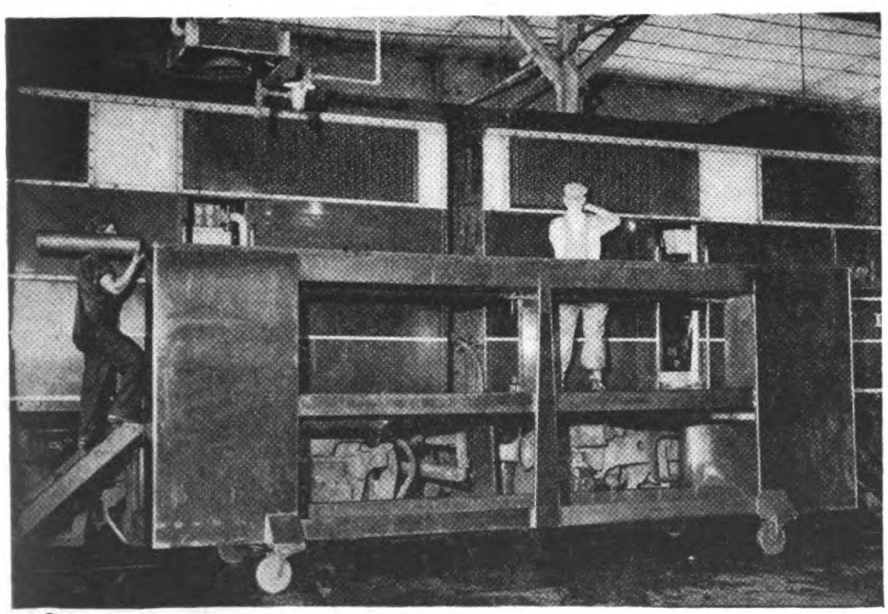
A.—When a crack in the firebox side sheet extends from staybolt hole to staybolt hole, it is satisfactory to weld it if the crack is in a straight line. In no case should any crack so welded extend through more than two staybolt holes. If the crack extends through more than two holes or if there are other cracks adjacent to it a patch should be used.



Welding cracks in firebox sheets

The general practice in repairing a crack in the firebox sheet is to cut out the crack with an acetylene torch as illustrated in (*b*) of the drawing, making the smallest cut possible. Next the edges of the crack are upset as shown in view (*c*) driving the plates in from the fireside of the sheets and forming a V-shaped opening as shown in (*d*). The entire opening, including the staybolt holes is then welded as shown in (*e*), and redrilled and tapped for staybolts.

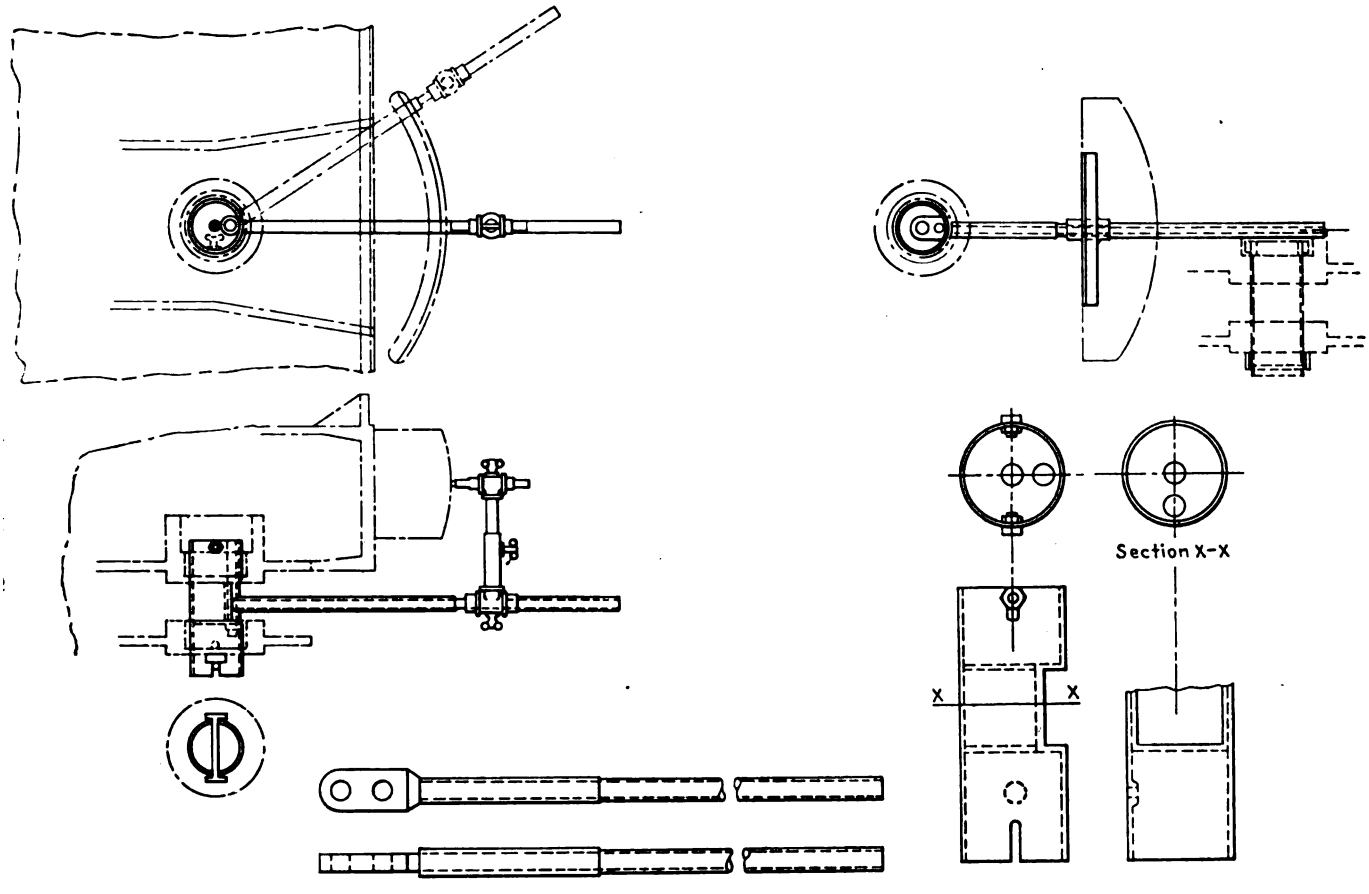
* * *



A movable working platform which has shelves for parts and tools needed in the repair of Diesel-electric locomotives.—It is in use at the Willard, Ohio, shop of the Baltimore & Ohio

Overcoming Hot Engine-Truck Boxes

Some roads are still confronted with the problem of eliminating hot engine-truck boxes on locomotive equipped with wedge-type radial buffers. The problem was solved on one road because of frequent derailments. Trouble was experienced with locomotives being derailed after negotiating a 17-deg. curve entering a station. While negotiating this curve the radial buffer would move in excess of its normal travel and, sometimes, would stick. The locomotive would then move onto tangent track in a cocked position and derail at the first frog.



Radial-buffer checking device

This condition was so aggravating that the chafing iron on the locomotive was turned at a radius 1½ in. less than the radius at which it was set. With this arrangement the adjusting wedge was set on straight level track to insure it against being too tight. Then, when the locomotive negotiated a curve the chafing iron would relieve itself and no further trouble was experienced with derailments.

Before the use of this arrangement, hot engine trucks were almost an every day experience. After this change was made in the machining and setting of the chafing iron, hot engine trucks stopped almost entirely. During the year 1944 an average of only one hot engine truck bearing was experienced for every six million locomotive miles run.

The drawing shows a checking device used for setting of the chafing irons. A bushing which holds the checking arm is inserted in the drawbar-pin hole. Two holes 1½ in. apart are provided to set the bushing square in the hole. When the bushing is set and secured, the center pin used to square the bushing is removed and the checking arm is radiated from a hole 1½ in. ahead of the center. This provides a perfect setting of the chafing iron to be made in the final installation. With this arrangement the wedge must have a device for positive setting to prevent it crawling on curves. This can be accomplished by the use of an ordinary driving-box wedge bolt.

Squaring Driving-Wheel Centers

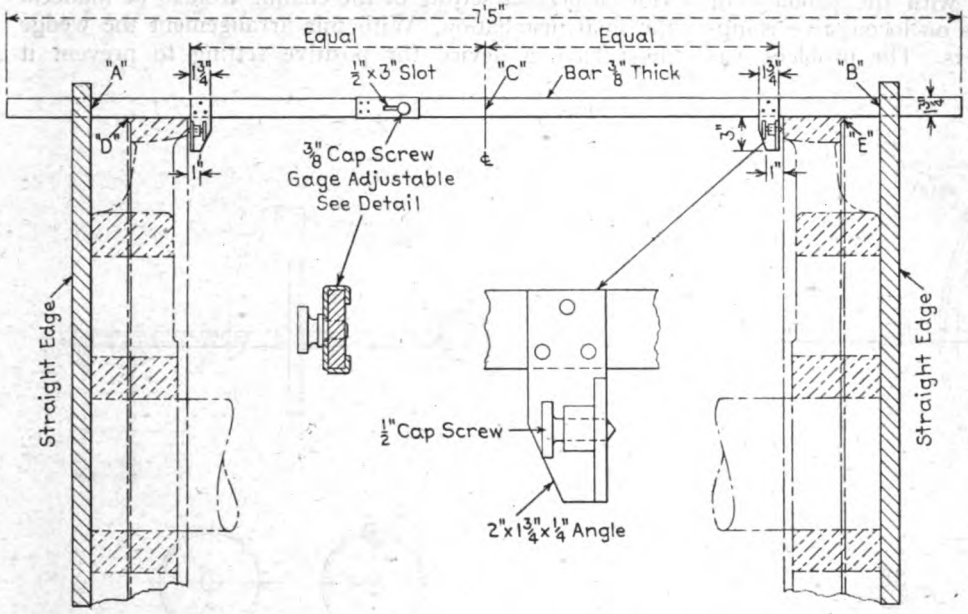
The importance of squaring driving-wheel centers and mounting tires so that they will be properly centered, spaced and run true is of course generally recognized and the gage shown in the illustration is an important aid in achieving these objectives at the Silvis, Ill., locomotive shop of the Chicago, Rock Island & Pacific.

In the drawing is a gage and method of squaring wheel centers to permit the proper application of driving tires so that flange wear will not develop. The gage consists of two strips of ⅜-in. by 1¾-in. steel, having a riveted bracket and ½-in. cap screw near one end of each and joined a little off center by a double-flanged slide fitting which permits adjusting the strips and bracket spacing any amount up to 3 in. by means of a slot and cap screw.

A straight-edge is laid against the hub of each wheel center, the gage being placed between the wheel centers as illustrated. Line *A* is scribed from one straight-edge and Line *B* from the other, center line *C* being then es-

tablished on the gage midway between these two lines. It is obvious that, since the outer edges of the wheel centers at *D* and *E* serve to position the driving wheel tires and flanges, the wheel centers must be machined, or turned to make distances *AD* and *BE* equal. Moreover, they must be such that, when tires are applied up to the lip on each, the spacing back to back will be 53¼ in.

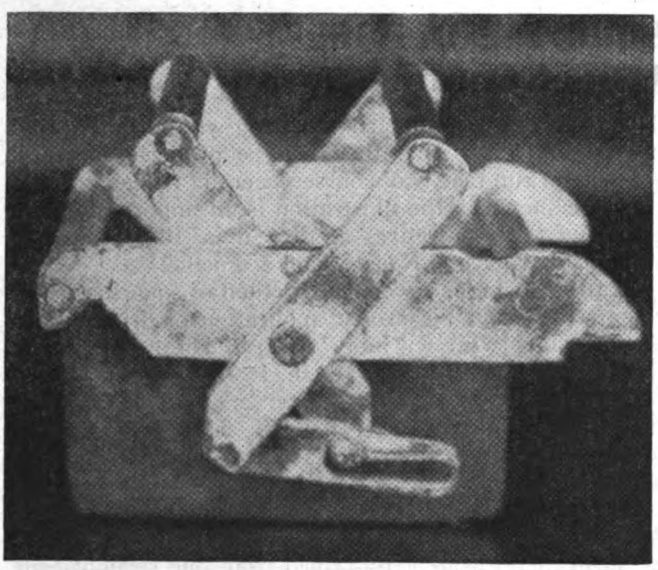
The practice in boring tires on the Rock Island is to leave a lip on the tire so as to permit it to face against the outside of the wheel-center rim, as stated. Subtracting the desired back-to-back spacing of the tires from the distance *DE* will give twice the depth which the tires must be bored from the outside face to the lip.



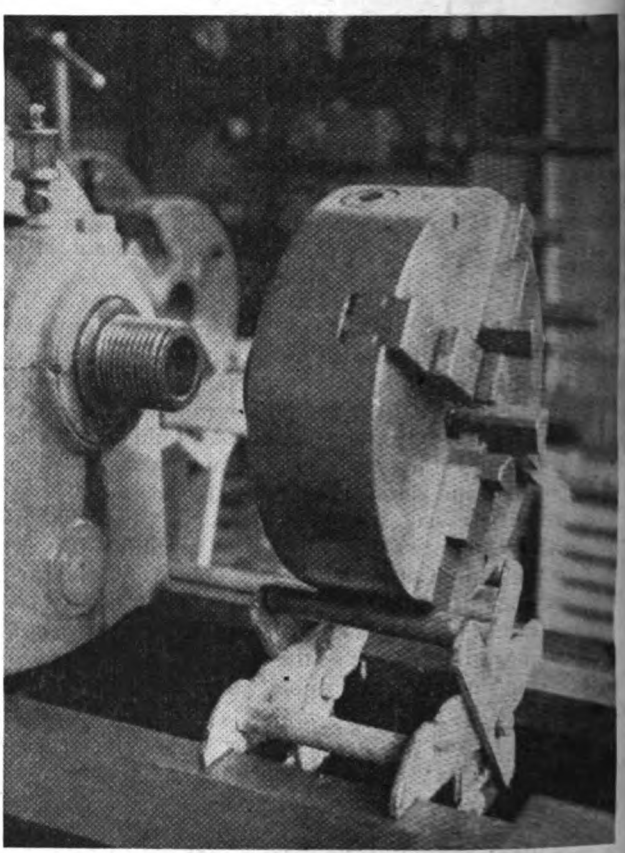
A gauge and method of squaring driving-wheel centers and spacing tires

Steady Rest For Lathe Chucks

The toolroom foreman at the Princeton, Ind., shops of the Southern has developed the steady rest shown for applying or removing chucks on a lathe spindle. As shown the rest sits upon the carriage ways on the lathe and supports the chuck while it is run onto or off the spindle. It is so made that either large or small standard chucks fit upon the same rest depending upon whether it is in the raised or collapsed position. The supporting cross-pieces on the rest revolve so that a chuck can be applied to or removed from the spindle by hand with a minimum of effort.



The steady rest can be adjusted to accommodate various sizes of chucks



A lathe chuck in position on the steady rest which moves on the carriageways of the lathe

With the Car Foremen and Inspectors

Wheel Car and Wheel Dollies

The idea of the wheel car, shown in the illustration and originally suggested by the Chicago, Milwaukee, St. Paul & Pacific has been adopted by the Northern Pacific and used with good results, 25 of these cars being now in service and 10 more now under construction. Among other advantages, the following have been listed, as compared with handling wheels by the former practice on flat cars.

Full Utilization of Weight Capacity of Car: By reason of double-tier loading, 38 or 39 pairs of wheels can be loaded on a 36-ft. car, whereas but from 19 to 20 pairs may be single-tier loaded on a 40-ft. flat car. One special car thus does the work of two ordinary flat cars.

Labor Saving: The provision of wells or slots in channels permanently secured to the car deck, into which the lower tier of wheels is placed, and the interlocking method of loading upper tier of wheels eliminates costly blocking required when loading wheels on ordinary flat cars.

Safety: The manner of loading on this special car eliminates danger of the load becoming disarranged and possibly dislodged due to failure of blocking to hold on ordinary flat cars under switching shock.

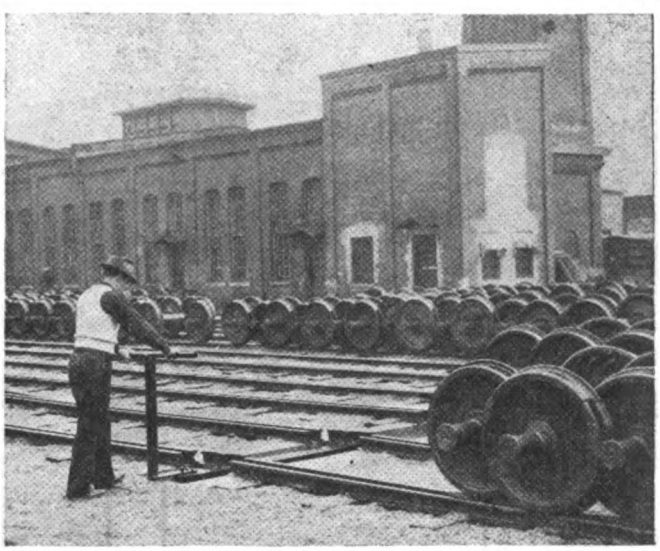
Reduced Damage to Axles: The liability of axles becoming damaged by reason of disarrangement of the load is eliminated.

Reduced Car Maintenance Cost: Decks on ordinary flat cars are severely damaged and require frequent replacement when cars are used for handling mounted wheels.

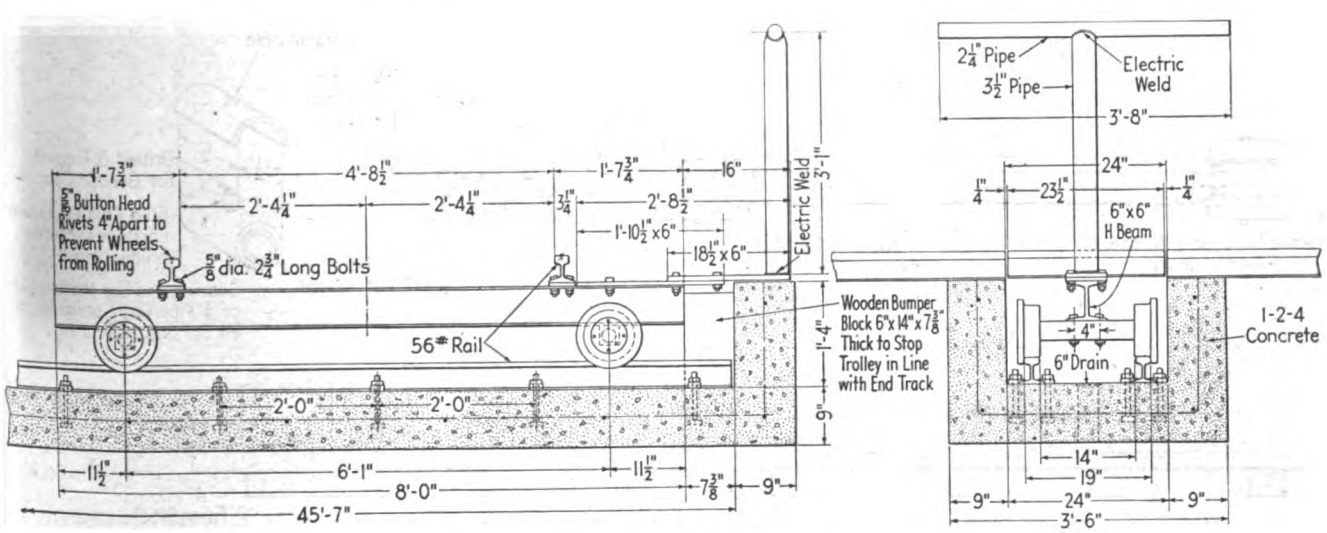
In view of these evident advantages, plans were developed on the Northern Pacific and, in the early part of 1942, ten cars were constructed for trial use between the South Tacoma wheel shop and repair tracks at Pasco and Parkwater, Wash., and Missoula, Mont.

Cars were constructed from the underframes and trucks salvaged from condemned 36-ft. 40-ton box cars, utilizing second-hand beams and channels for slotted wheel-carrying members and their supports.

The use of these 10 cars proved that anticipated advantages were realized and in 1943 an additional 15 cars were constructed for use in handling mounted car wheels between three additional wheel shops and 10 additional repair track points. The Northern Pacific is now constructing 10 additional cars for handling mounted freight car wheels between wheel shops and four additional repair track points, also five similar cars with wheel slots arranged for handling 36-in. steel passenger-car wheels between the South Tacoma wheel shop and the Seattle



Wheel-transfer dolly in operation at the Como shops



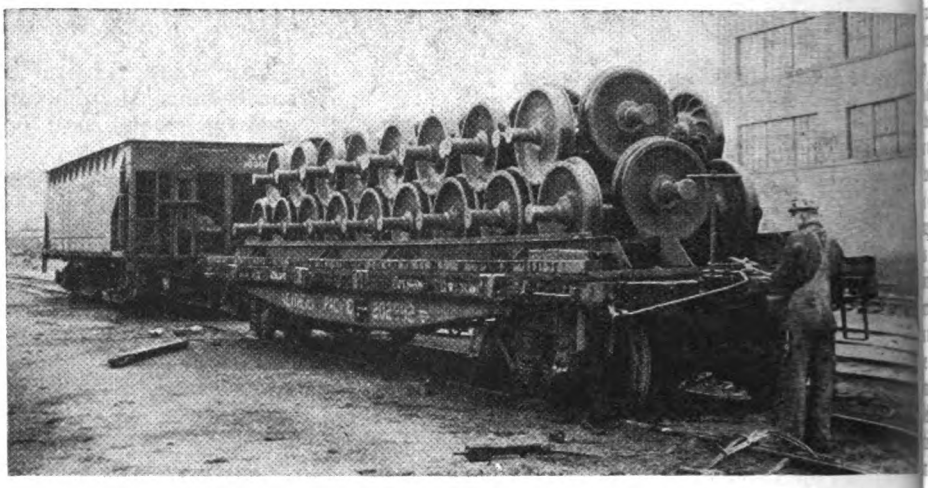
How the wheel dolly is built at Como shops

coach yards, also at the St. Paul shops and coach yards.

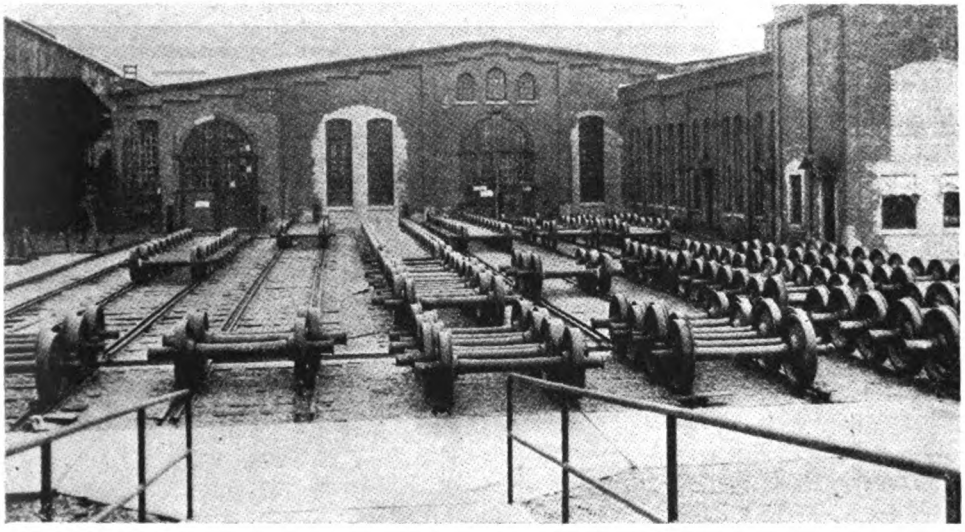
It is expected that, by the end of this year, a total of 40 of these special wheel cars will be in service hauling mounted car wheels between four wheel shops and 19 repair points and coach yards on the Northern Pacific.

Wheels are loaded on and unloaded from cars at wheel shops by means of locomotive type cranes which are also used for loading and unloading other types of materials used in railroad shops. At repair points, wheels are loaded and unloaded by means of jib cranes, fitted with 1½-ton air-motor-operated hoists.

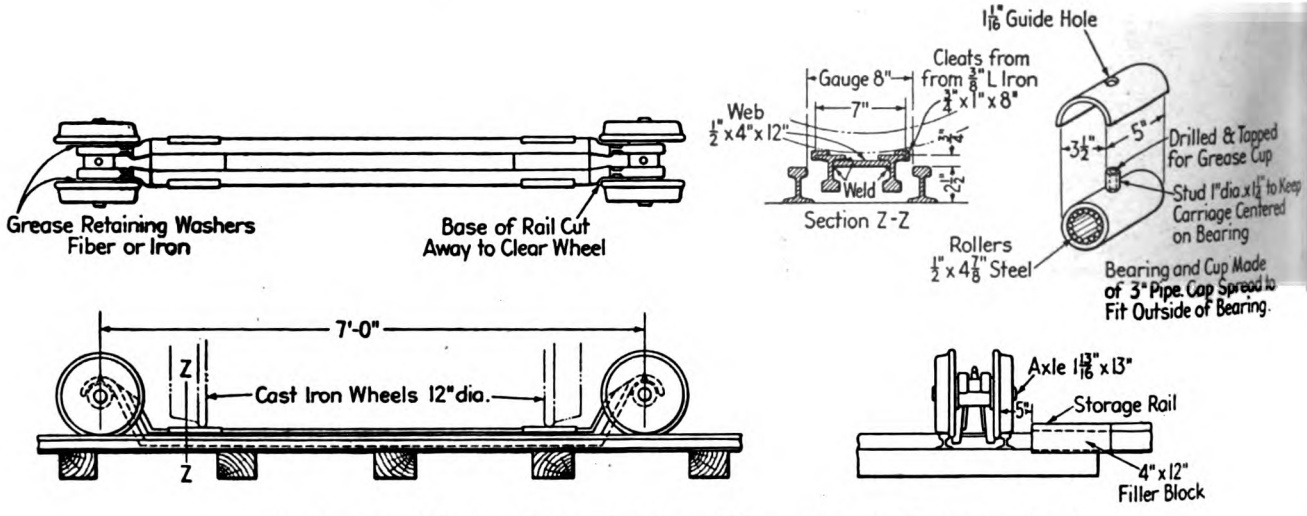
Double-track wheel storage facilities are provided at repair points, where wheel carriage dollies or transfer tables are used for transferring wheels in the storage area.



Wheel car which is being used on the Northern Pacific



Typical wheel storage tracks at Northern Pacific shops



Another type of Northern Pacific wheel dolly which can be used without a transfer pit

Small wheel transfer tables of the design shown in one of the illustrations are in use at Livingston and Como shops. No cars are moved over wheel storage tracks so no bridge across the break in the rails is needed.

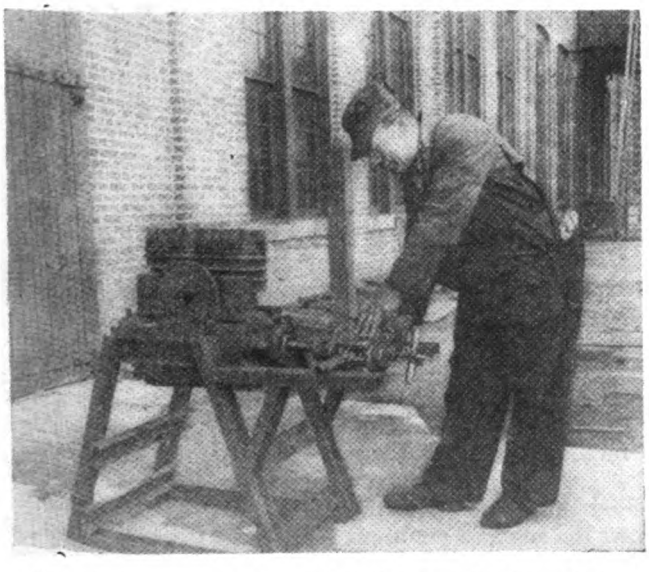
Referring to the drawing, it will be noted that this wheel dolly consists of a 6-in. H-beam, 8 ft. long, mounted on flanged wheels which roll on two 56-lb. rails in a 24-in. by 16-in. pit crossing the wheel storage tracks at right angles. The H-beam carries two short sections of rail which bridge the gap over the pit and two slight depressions ground in the short rail sections serve to keep a pair of wheels in place after being rolled onto the dolly. A substantial vertical post and cross handle on the dolly enable it to be easily pushed in line with any pair of tracks in the wheel storage area.

Another type of wheel dolly, which is successfully used on the Northern Pacific for transferring wheels at storage tracks and has the advantage of not requiring a cross pit in which to operate, is shown in the second drawing. This consists of a double inverted rail construction, quite sharply turned upward at the ends and bent to enclose bearings for four carrier wheels which move on two cross tracks extending at rail level over the storage tracks.

Reference to the drawing will show the construction of this dolly. The double-wheel centers are spaced 7 ft. apart and the depressed inverted rails move between the cross rails at a level only slightly above them. A pair of wheels, easily rolled onto this dolly, is automatically centered and may then be moved to any pair of tracks in the storage area. No handle is provided on this dolly, which is readily moved by pushing on the wheels.

Freon Compressor Repair Stand

In the maintenance of passenger-car equipment, overhauling and testing Freon compressors is an important detail and this work is greatly facilitated at the Burnside, Chicago, shops of the Illinois Central by a special stand on which the compressor is placed and handled throughout the entire operation. Prior to development of this stand, the Freon compressors had to be moved by an overhead crane to the shop bench, which meant waiting until one was available. After placing the compressor in position for overhauling it had to be changed in position frequently, involving considerable manual labor and entailing some danger of pinched fingers if not more serious hand injuries.



Freon compressor stand developed at the Burnside shops of the Illinois Central

Under the new arrangement, the compressor, which weighs approximately 450 lb., is handled by a boom crane and hoist and placed on the stand where it is conveniently and safely overhauled by means of a revolving device. A circular plate with a shaft extending out about 6 in. is fastened to each side of the compressor, and one plate has a series of holes drilled around its circumference to provide a locking arrangement to hold the compressor in any position desired. This facilitates easy working on any part of the compressor simply by revolving it in the stand. Two arms extending from the stand, which consists essentially of small steel channel sections joined by welding, support the air motor used in running and testing the compressor oil seals.

When repairs are completed, the air motor is placed on the arms and connected to the compressor, and after the motor is started, no further attention is required. Formerly constant attention was essential while the compressor was being tested. By eliminating the hazardous and inconvenient method of handling these compressors under the old method, repairs and tests can be made faster and with greater safety.

Air Brake Questions and Answers

HSC Equipment on Passenger Cars and Diesel A and B Locomotive Units Brake Application

307—*Q.—How does the speed governor function when train speed reduces below 40 m.p.h.?* A.—As train speed reduces below 40 m.p.h. the speed governor de-energizes the *M* magnet, which causes the release of pressure from diaphragm chamber *N* through choke *140* and the inshot portion exhaust, and thus establishes the 60 per cent ratio on diaphragm 64.

308—*Q.—How does the speed governor function when train speed reduces below 20 m.p.h.?* A.—As speed reduces below 20 m.p.h. the speed governor energizes the *L* magnet, which causes the release of pressure from diaphragm chamber *K* through choke *142* and the inshot valve exhaust.

309—*Q.—What controls the rate of reduction in braking pressure as the train speed decreases?* A.—The chokes *138, 140,* and *142* control the rate of exhaust from diaphragm cavities *P, N* and *K* to produce a gradual reduction in braking pressures as train speed decreases.

310—*Q.—Referring to the quick service valve (Fig. 28), what takes care of brake fluctuation sufficiently to reduce the brake pipe pressure?* A.—Air from the straight air pipe builds up through passage *4* and chamber *C* under diaphragm 22. At approximately 5 lb. this pressure overcomes spring *29* and deflects the diaphragm *22,* moving the follower and its guide. Spring *28* is compressed and seats cut off valve *27,* closing connection between passage *3* and the exhaust *EX*. In the event that the brake pipe pressure in chamber *A* is reduced due to local brake fluctuation, a reduction in brake pipe pressure will be prevented by the closed cut off valve.

Release After HSC Application

311—*Q.—How is the braking force reduced?* A.—By moving the MS-40 brake valve handle towards release position.

312—*Q.—Does this movement fully release the braking force?* A.—No. The brake valve handle must be placed in release position for full release.

313—*Q.—Explain how the straight air pipe pressure is reduced during the operation of the master controller (Fig. 32) to correspond with the reduction of control pipe pressure.* A.—When the control pipe pressure in chamber *B*, acting on the diaphragm *18* of the master controller, is reduced below the straight air pipe pressure in chamber *A* on the face of the release diaphragm *18a*, shaft *32* of the master controller is moved and opens contact lever *41* and the release (Rel.) contact to de-energize the release wire and, therefore, the release magnet of the *21-B* magnet valve. Spring *35* then unseats release magnet valve *62* on the *21-B* magnet valve, opening the exhaust so that pressure from passage *4a*, the straight air pipe and diaphragm chambers of the F 1864 or FS 1864 relay valve, is reduced the same amount that control pipe pressure is reduced.

314—*Q.—Explain the movements that bring about a reduction or release of brake cylinder air.* A.—As stated, a corresponding reduction is made in the relay valve diaphragm chambers A, K, N or P, whichever is in control. As the pressure is reduced in passages *16, 16a* and the check valve chamber, the greater pressure in the controlling diaphragm chamber K, N or P, lifts check valves *51, 51a* or *51b* and reduces into passage *16*. After the pressure is reduced in passage *16c* and chamber *C* below the inshot spring valve, spring *88* returns the inshot piston *84* and diaphragm *85* and opens supply valve *92*. As the pressure is removed from the diaphragm side of main diaphragm *38* the higher brake cylinder in chamber *F* of the relay portion and spring *42* return piston *36*, and its lever *43*. With pressure removed from exhaust valve *23* and its piston *25*, brake cylinder pressure opens them and flows to the atmosphere.

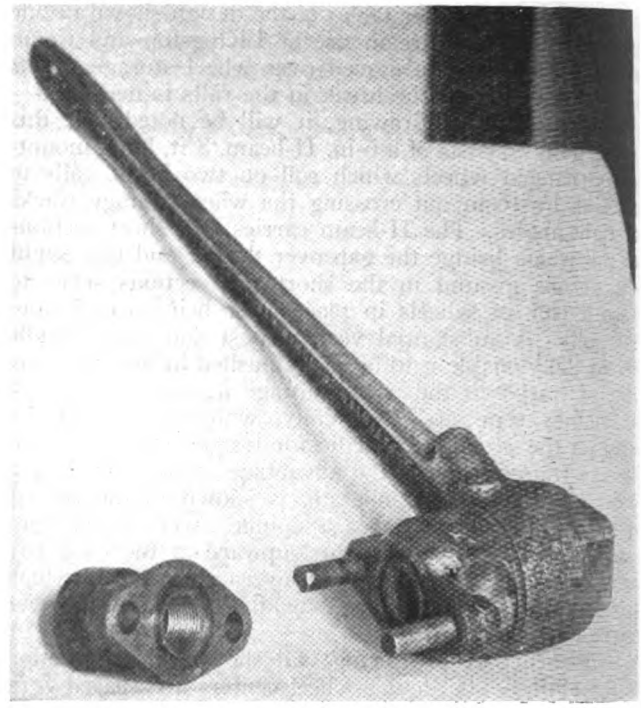
315—*Q.—How does this work out when making a graduated release?* A.—In making a graduated release, the relay portions of the relay valves will lap and retain brake cylinder pressure in accordance with the lapping action of the master controller so that brake cylinder pressure can be released in small increments to produce a smooth stop.

Emergency Application

316—*Q.—During an emergency application, how is the self lapping portion affected?* A.—During an emergency brake application, which is obtained by moving the MS-40 brake valve handle to the extreme right, the self lapping portion immediately produces electro-pneumatic application as described under service brake operation.

A Ratchet Coupling Wrench

Among the special tools used to expedite car work at the Michigan City, Ind., car shops of the Pullman-Standard Car Manufacturing Company is a special head applied to a ratchet wrench and used to apply couplings of the type illustrated in air-brake pipe lines on freight cars. This coupling is an awkward fitting to screw onto a pipe thread, especially in close quarters under a car, and the use of a dummy half coupling on the ratchet wrench with two studs to engage holes in the coupling which is being applied eliminates danger of pipe wrench slippage, or constantly readjusting the pipe jaw opening, as would be necessary when using a standard pipe wrench for this operation.



Ratchet wrench equipped with special head for use in applying couplings in freight-car brake lines

Decisions of Arbitration Cases

(The Arbitration Committee of the A. A. R. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Wheel Changes By Terminal Company

Chicago & Illinois Midland (Mather) box car 8181 was received on the Peoria & Pekin Union rails from the C. & I. M. and while the car was in that company's account wheels were changed by the P. & P. U. account of owner's defect and new wheels were applied. A week later while the car was still on the P. & P. U. but was then under load in the New York, Chicago & St. Louis account, the P. & P. U. replaced the new wheels with a pair of second-hand wheels account cut journal. The Mather Stock Car Company contended that the P. & P. U. charge should be confined to second-hand wheels and cited Rule 98, Paragraph (b-8). The railroad contended that the rule did not apply inasmuch as the change in the first instance was made for the account of one road and in the second for the account of another. Between the times of the wheel changes the car had moved over the

lines of the N. Y. C. & St. L. The second wheel change had been billed against that company as a handling line responsibility and the owner had been so notified.

In a decision rendered on November 18, 1944, the Arbitration Committee held that, "Inasmuch as wheels were changed by the Peoria & Pekin Union for two different railroads, Paragraph (b-8) of Rule 98 does not apply. The contention of the car owner is not sustained. The principle of Decision No. 1485 applies." *Case 1807, Mather Stock Car Company vs. Peoria & Pekin Union.*

Charges for Repairs in Kind

The Seaboard Air Line applied a lever-type end steam valve to a refrigerator car of Pacific Fruit Express Company ownership showing the same type to have been removed because it was broken and basing its charge and credit on the value of material applied and removed. The owner asked verification of the type of valve removed stating that screw-type valves were standard to the car and that there was no record showing the application of a lever-type valve by any other company. The Seaboard was requested to reduce its billing to the value of a screw-type valve. It refused to do this and verified the fact that a lever-type valve had been removed. The owner believed that the principle of the fourth interpretation following Passenger Car Rule 16 was applicable but the railroad did not agree. According to the owner screw-type valves were standard although it had not previously claimed wrong repairs in cases where lever-type valves had been substituted.

The Arbitration Committee ruled on April 12, 1945, that, "Inasmuch as the Seaboard Air Line applied the same type of end steam valve as was removed from the car and the car owner has not furnished satisfactory evidence of type of valve standard to the car, charge and credit should be on the basis of material applied and removed. The contention of the Pacific Fruit Express Company is not sustained." *Case 1808, Pacific Fruit Express Company versus Seaboard Air Lines.*

Dismantlement Is Choice of Car Owner

Gulf, Mobile & Ohio all-steel box car No. 5663 was extensively damaged by fire on the Chicago, Rock Island & Pacific. Numerous necessary repairs were made to put the car in shape to move home and defect cards for additional damage were attached to the car. The car owner was not advised of the extensive damage done to the car prior to its being shipped home. The contention in the case on the part of the owner was that the car should be settled for on the basis of depreciated value, the car was a little more than year old. The Rock Island insisted that the car could be repaired at a cost less than the depreciated value. Three joint inspections had been made of the car, the first by a representative of the owner and one from a disinterested railroad, the second by a representative of the Rock Island and one from a disinterested road, and the third, a more complete report, by the owner and a representative from a disinterested road. The main points in issue involved the possible safe reuse of many parts which had been subjected to heat from the fire in which the car was damaged. The Rock Island refused to issue additional defect cards covering damaged parts listed in the itemized joint inspection certificate furnished by the car owner. According to the owner the two points at issue on which decision was requested were: (1) Should this car have been reported under Interchange Rule 112 as a destroyed car? and (2) should not the Rock Island issue its defect cards to cover all defects enumerated in the G. M. & O.'s joint inspection certificate, this being a requirement of Interchange Rule 4, Section (k), Paragraph (1)?

In a decision rendered on April 12, 1945, the Arbitration Committee ruled that, "Decision as to whether a car should be repaired or dismantled rests with the car owner and, on that basis, bill should be rendered under the provisions of Rule 112, if car is repaired, or under the provisions of Rule 94 in effect on date car was damaged if car is dismantled. In either event, bill should be rendered on authority of defect cards issued on basis of joint inspection certificate executed by representatives of owner and the Illinois Central dated November 24, 1943." *Case No. 1809, Chicago, Rock Island & Pacific versus Gulf, Mobile & Ohio.*

A Simple Cotter-Key Puller

The cotter-key puller here illustrated is in use at the Michigan City, Ind., car shops of the Pullman-Standard Car Manufacturing Company. It consists simply of the usual puller, made with a straight round rod and sliding steel sleeve or handle which slides easily up and down on this rod and is stopped at the lower end by a nut.

Cotter puller with sliding steel cylindrical handle which saves time and skinned knuckles

In operation, the reduced diameter goose-neck end of the puller is inserted in the eye of the cotter key and a few quick downward strokes of the fairly heavy steel cylindrical handle against the bottom nut serves to pull out the cotter without the necessity of straightening the cotter legs or using a hammer as is usually done on some part of the cotter puller. Time is saved, and what is possibly even more important, skinned knuckles are avoided.

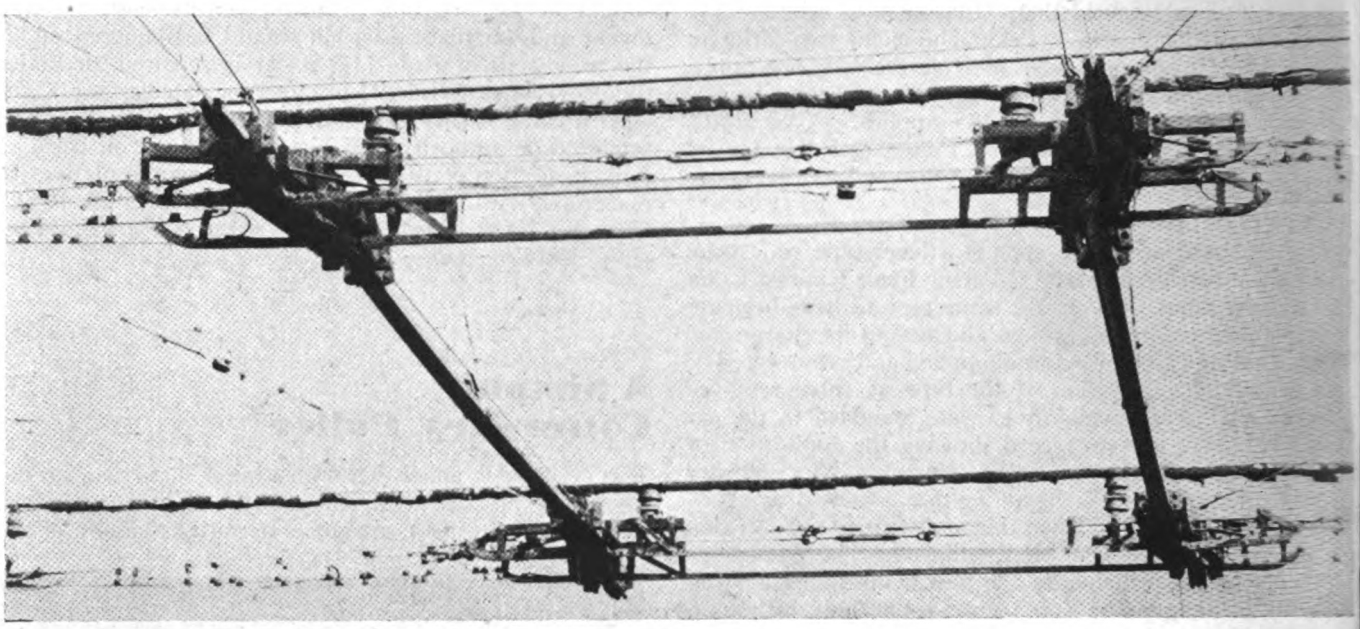


Fig. 1—Original inverted trough type of crossing which required I. C. trains to coast with power off

Two-Voltage Trolley Crossings

Illinois Central develops arrangement which permits freedom of operation by both lines

GRADE crossings of two overhead electric traction lines having different voltages has been made possible with control on (without the need for coasting), by a notably ingenious development on the Illinois Central. The crossings involved in this instance are six which the Illinois Central has with the Chicago Surface Lines. The voltages on the two lines are respectively 1,500 and 600 direct current.

The original type of crossing which required that Illinois Central trains coast over with no power on is shown in Fig. 1. The Surface Line cars, moving in and out of the picture employ a trolley pole with a wheel which moved along the wire to the inverted trough having an offset at either end over the two Illinois Central tracks, and then out of the trough and back onto the wire at the other end of the trough. This required slow operation and frequently resulted in the trolley coming off the wire as it emerged from the trough.

The Illinois Central trains use pantograph collectors and these moved laterally over the crossing as shown in Fig. 1. Insulators in the 1,500-volt contact line on either side of the crossing separated the two power systems and it was necessary for Illinois Central trains to have enough speed to coast over the crossings. The offset in the troughs permitted the pantographs to slide under them without catching, but it involved a roughness of operation which probably increased pantograph maintenance costs.

The new type of crossing which is located at 71st Street and Stony Island is shown in Figs. 2 and 3. The two Surface Line wires move in and out of the picture and the Illinois Central lines across. The four bow-shaped pieces of hardware carry the Surface Line trolleys down to the level of the Illinois Central contact wires and also permit the Illinois Central pantographs to slide by. The four insulators A, B, C, and D, separate the Illinois Central contact wire electrically from the Surface Line wires.

There are also two other insulators in each Illinois Central line approach to the crossing. These are shown as E and F in Fig. 3. Insulator A is shown in both Fig. 2 and Fig. 3.

Trains approaching the crossing from the left in Fig. 3 are just leaving a station and each two-car unit is drawing a maximum of 800 amperes at 1,500 volts from the contact wire. Insulator F is a blow-out insulator and when a pantograph reaches this insulator it slides from a live to a dead section and the resulting arc is blown out. This drops out the line breakers since they are held in by 1,500 volt coils and the pantograph moves across the crossing until it reaches the live 1,500-volt wire on the other side when the line breaker picks up and the unit goes into service again. The motorman may keep his controller on as the train goes over the crossing and each unit drops out and picks up again as it passes.

The section of the Illinois Central wire between in-

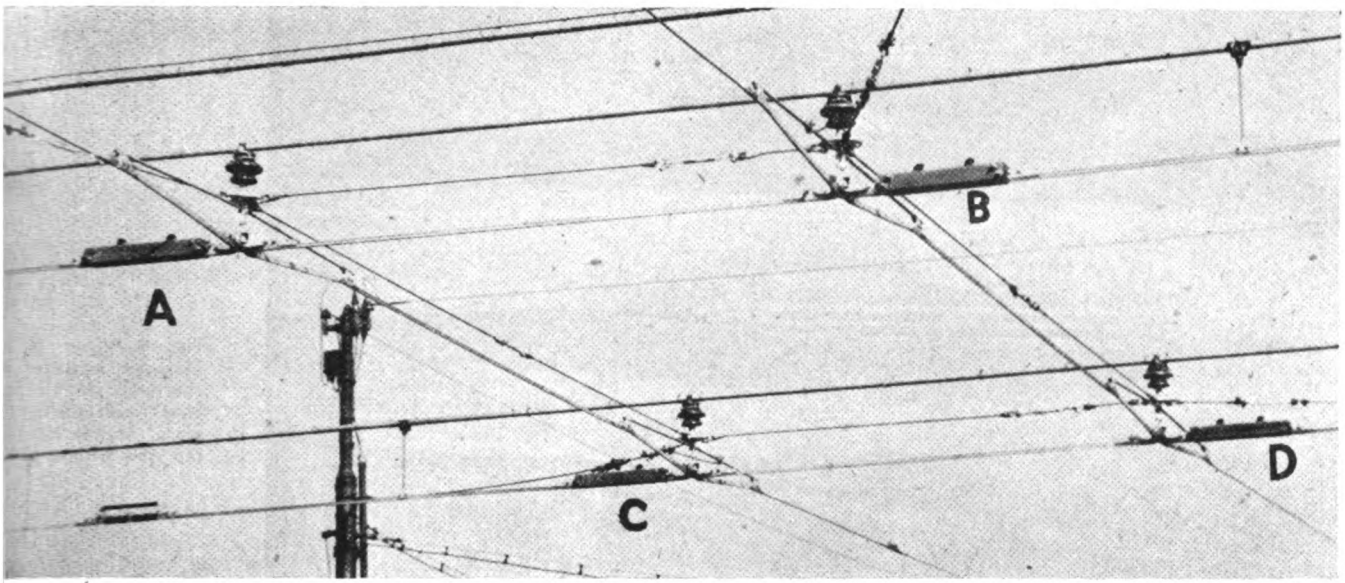


Fig. 2—New type of crossing showing the Chicago Surface Line wires running in and out of the picture and the Illinois Central wires laterally across—The insulators A, B, C and D are in the I. C. wires

sulators A and B Fig. 2, is energized with 600 volts d. c., but since the line breakers have dropped out on the Illinois Central cars as they pass this point, only the auxiliary circuits are connected and the current they draw at 600 volts is negligible.

The insulator E (Fig. 3) affords protection for a possible contingency. If it should happen that an Illinois Central unit should pass the blowout insulator F with both pantographs up, the section of the Illinois Central contact wire between F and the crossing might momentarily be made live. If at the same time, a Surface Line car should go over the crossing with its trolley off and swinging it might strike the Illinois Central wire. The insulator E would then keep the Illinois Central wire dead beyond the reach of the swinging trolley pole.

Blow-Out Insulator

The blow-out insulator shown in Fig. 4 successfully and continuously interrupts 800-amp., 1,500-volt arcs with no visible fireworks.

At the top is shown a side view, No. 2 and No. 4 are top views with and without the Transite arc baffles and

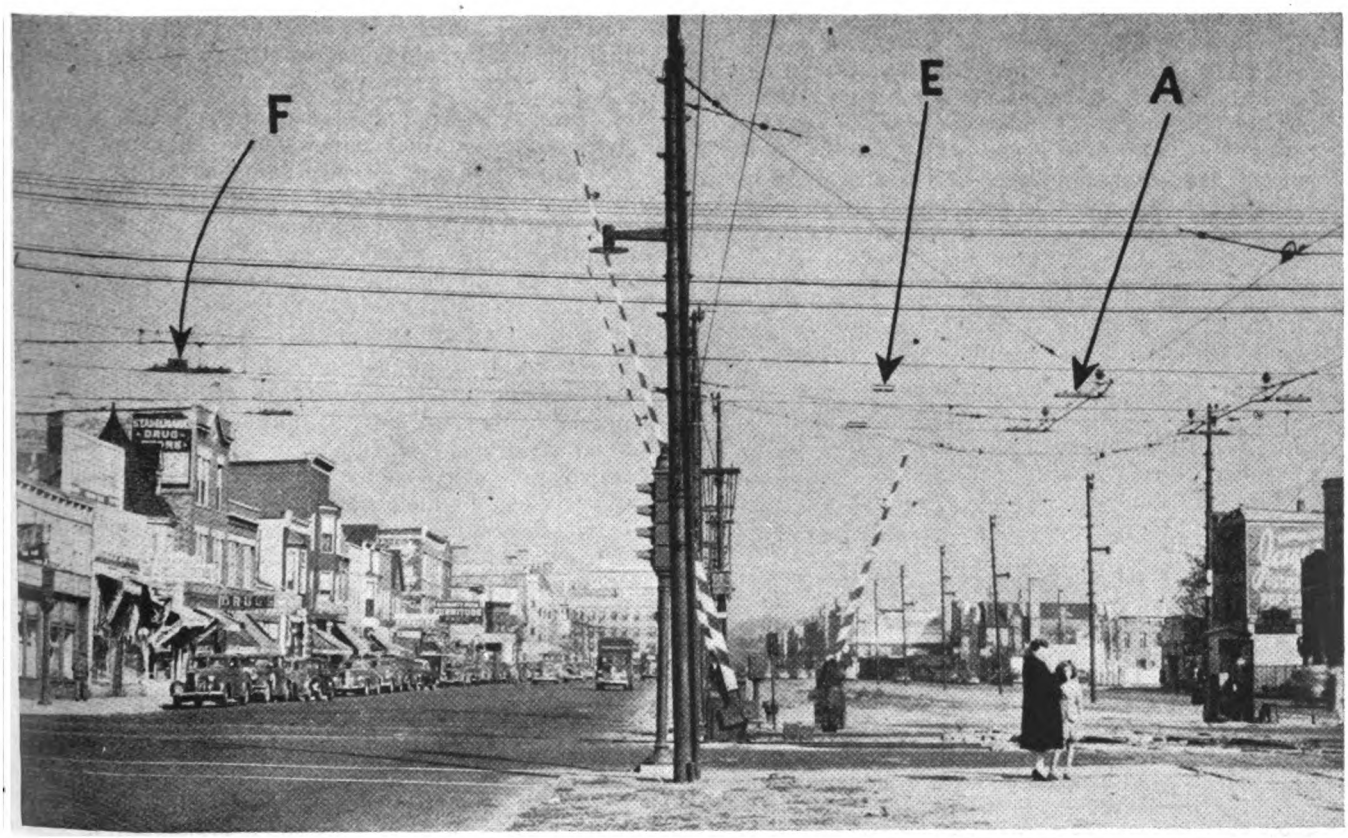


Fig. 3—Approach to the crossing at 71st Street and Stony Island—The blow-out insulator is shown at F, the emergency insulator at E, the insulator A corresponds to the one marked A in Fig. 2

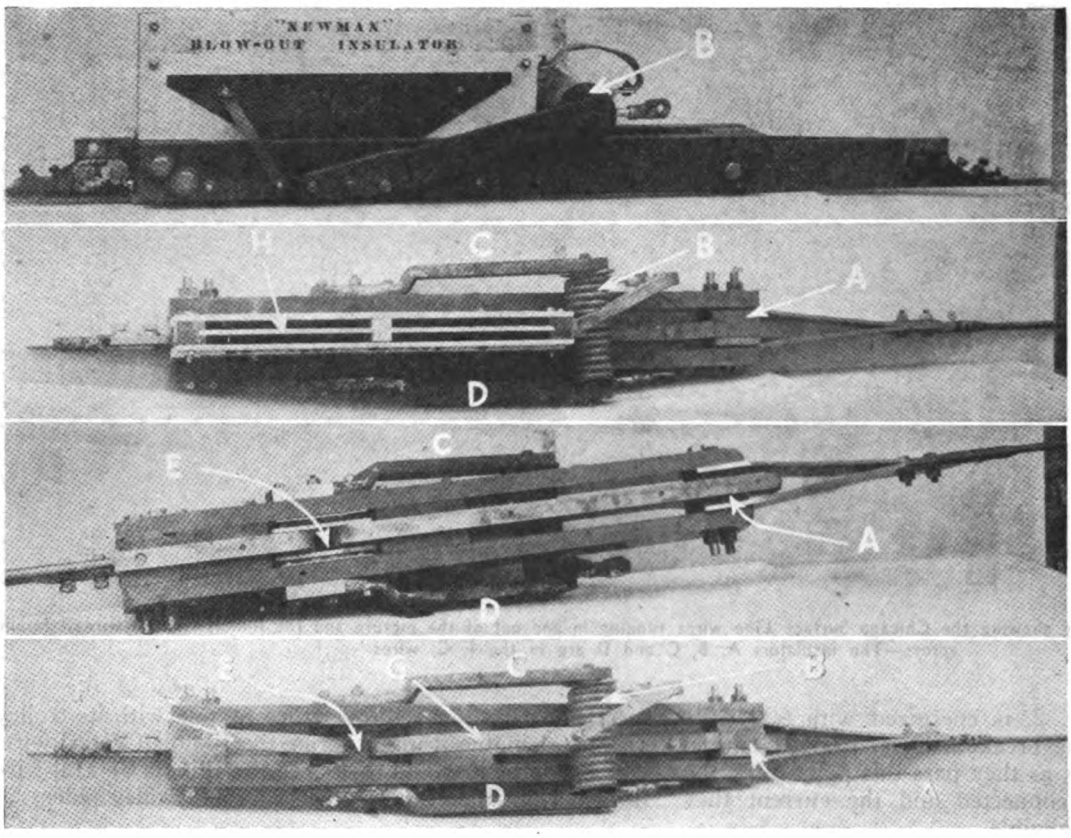


Fig. 4—Views of the blow-out insulator; respectively side view, top view with baffles in place, bottom view and top view without baffles

No. 3 is a bottom view. As a pantograph approaches the insulator from the right in view No. 3, it passes the insulated point A. The current then travels from the trolley wire through the blowout coil B (views 1, 2 and 3) and back to the pantograph along the center strip in view 3.

This energizes the magnetic circuit which is carried to the gap by the bars C and D (views 2, 3 and 4). When the pantograph reaches the gap E, the circuit is interrupted and the magnetic field blows the arc up through the horns F and G (view 4) and into the baffles H (view 2). These baffles divide the arc both laterally and horizontally. The insulator successfully extinguishes the arc at speeds up to 30 miles an hour, which is the maximum operating speed over these crossings.

In addition to the crossing at 71st Street, there is one at 92nd and Exchange Streets, and another at 121st Street and Michigan Avenue. Three more will be installed.

The work was engineered and installed by C. R. Wadham, assistant engineer, and H. H. Newman, General Foreman, Illinois Central.

Train Telephone Operators Need No Licenses

Railroad employees will not be required to hold operator licenses to operate radio equipment which may be installed by the carriers, according to Order No. 126 issued by the Federal Communications Commission on August 21. The order was an exercise of the commission's authority to waive the licensing provisions of Section 318 of the Communications Act of 1934 in cases where it finds that the public interest, convenience or necessity will thereby be served.

The action, coming in response to a petition from J. J. Pelley, president of the Association of American Railroads, was taken "to facilitate the use of radio for increased efficiency and safety in railroad operations," the commission's announcement said. Mr. Pelley's petition had stated that the number of Class I railroad employees who might be required to use radio transmitting equipment in connection with their duties totals 463,568 and that this total would be increased by inclusion of Class II and III railroad employees.

The A.A.R. has prepared for the adoption of its member roads what the commission's order calls a "comprehensive set" of Railroad Radio General and Operating Rules governing the use of transmitting equipment. In this connection the commission has approved a procedure whereby prospective operators among railroad employees will be examined on these A.A.R. rules by railroad examiners. This will be in lieu of the commission's own examinations.

The order contained several conditions, including a requirement that adjustments to the transmitting apparatus must be made only by duly licensed operators. Another condition limits the order to employees of roads which have adopted the A.A.R. rules, although there is provision for modification by individual roads if they first obtain written approval from the commission. The first examination of a prospective operator must be conducted prior to his operation of any transmitting apparatus, and re-examinations are required at intervals not in excess of two years.

Also the order applies only to roads which "maintain suitable records showing the name and position of all employees who have been examined . . . the date of the employee's last successfully completed examination and the name of the railroad examiner." Finally, the railroads radio equipment "shall be so designed that none of the operations necessary to be performed during normal use of the equipment may result in any unauthorized radiation."

Train Communication Test Car

Rock Island develops rolling laboratory which can be hauled in fast passenger trains — Bunks and kitchen for 13 men

For the development and testing of train communication equipment, the Chicago, Rock Island & Pacific has installed test equipment, meters and other laboratory apparatus in a car that can be used on passenger trains as well as on freight trains. About a year ago some of this equipment was installed in a caboose, but such a car could not be hauled in fast passenger trains. In order to use the electronic laboratory in any train, either passenger or freight, a test car was equipped with high-speed trucks.

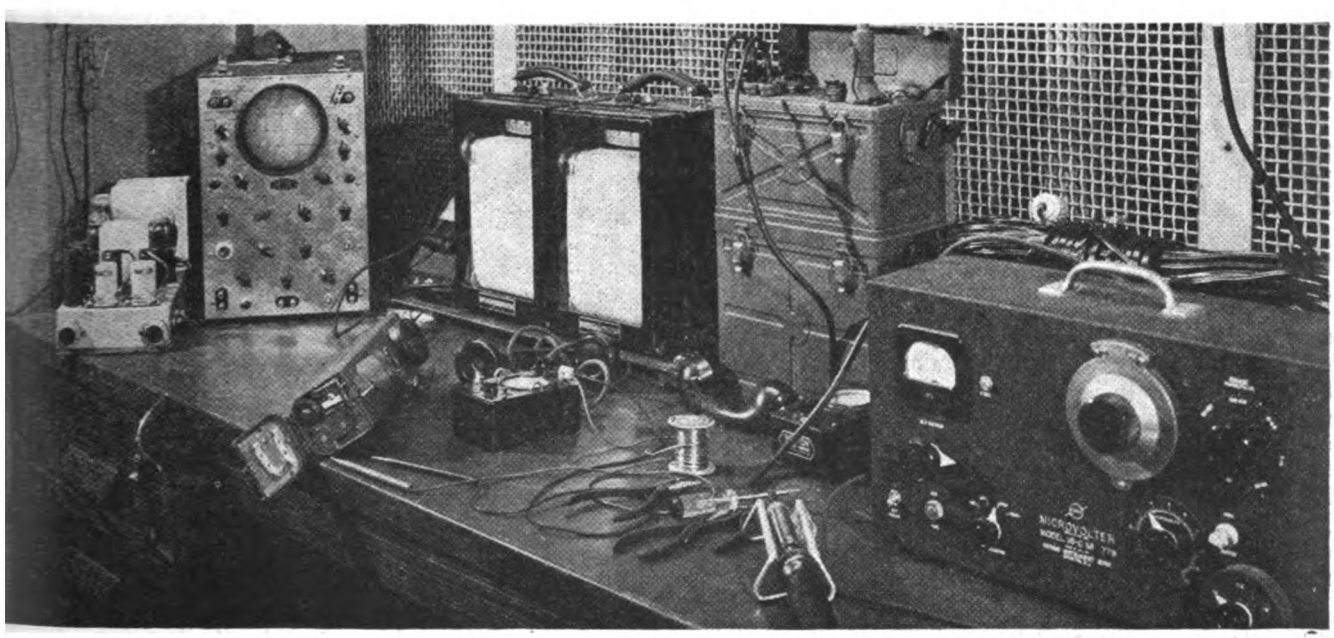
Work Room

The work room, including work benches and testing equipment, occupies the most important portion of this car. A combination office and radio room is located in the other end of the car. A separate small room, with sound-proofing, includes the gasoline-engine-driven generator. A small kitchen and bunks are available which will accommodate up to 12 or 13 men while on long trips. The equipment in the car includes communication apparatus furnished by various manufacturers, including the Galvin Manufacturing Corporation, the Bendix Corporation, Hallicrafters, and Communications Company, Inc., and also some specialized communication equipment developed by the Rock Island. The cathode ray oscillograph was made by Allan B. Dumont, the recording meters by Esterline Angus, the microvolter is from the Ferris Instrument Company, and the smaller portable electrical instruments are Weston. Various special pieces of apparatus were secured from the Sperry Gyroscope Company, the Dictaphone Corporation and others.

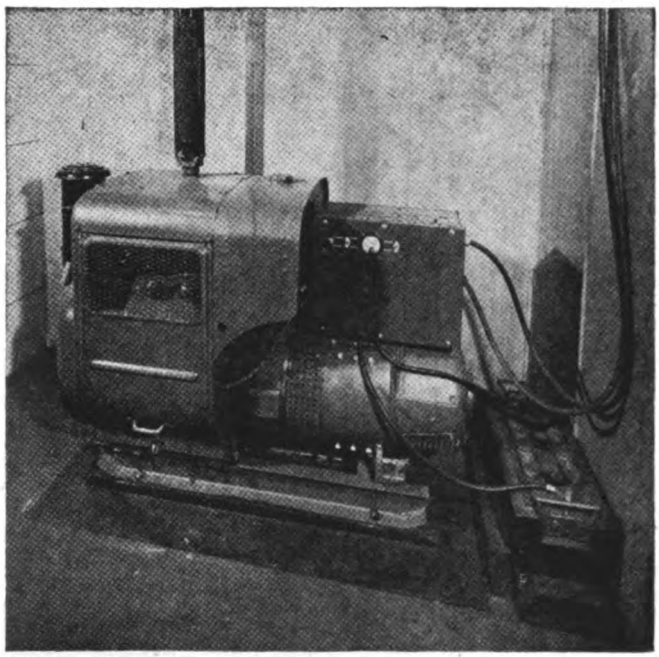
Radio Apparatus

The car has three antenna. One which is on top in the form of a vertical member with four horizontal members beneath it, works with the 160-mc. experimental equipment on which the railroad is doing some research work. At the other end of the car is a long horizontal antenna mounted on insulators which connect to a receiver in the center of the car. This unit covers a range of 28 mc. through 145 mc. for general communications. The receive operates on FM and AM signals. On the end, and opposite the combination radio room-office, and on each side of the car are mounted the vertical steel rods which, when connected in parallel, comprise the antenna for the Motorola FM 30-40 mc. transmitter-receiver which is used for the usual communications with the wayside stations.

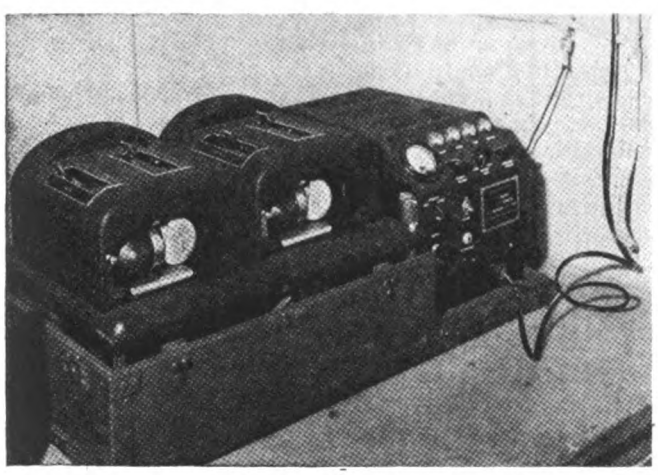
The Motorola FM receiver-transmitter in the office section of the car is operable with an ordinary type telephone handset, except that the impedence of the earphone has been changed to match the output of the receiver radio circuit. On the handle of the handset is a push-button which must be depressed to place the transmitter on the air. At the same time this deadens the receiver so that the earphone is non-operating. A loud speaker, located inside the console behind the grille can be used for reception and the earphone cut out. A second handset is located in the laboratory room at the other end of the car. The console can be remotely operated from that position, since under normal conditions no care or observation need be made at the console location during its operation. The unit is used for main communications with the stations on the railroad where similar equip-



The work-bench in the laboratory room of the car



The Pioneer five-kva. gas-electric Gen-e-Motor used to supply power for the receiver-transmitter



Dictaphone apparatus for recording incoming and outgoing telephone conversations

ment has been or is being installed. The set operates while the car is in motion or stationary.

Primary power is furnished to the set at 115 volts a.c., from a Pioneer Gen-E-Motor 5 kv. gas-electric generator located in the power plant room at the same end of the car as the laboratory.

Laboratory Equipment

The laboratory includes a long work bench—with several drawers. Tools, instruments, meters and trouble-shooting equipment are provided. On another table along the opposite wall is a portable Dictaphone recorder which can be "patched" into any circuit, whether radio or telephone, for permanently maintaining a running log or keeping a record of electronic or traffic observations. A telephone handset placed on the wall and connected to the Motorola console in the radio room permits its remote operation, and affords contact stations directly from the laboratory room.

Two Motorola handie-talkie sets and two Motorola walkie-talkie sets are kept in a small closet in the laboratory room. These are regular U.S. Army Signal Corps type, and are used by personnel when they must move away from direct contact with the car, yet maintain communications, especially in emergencies.

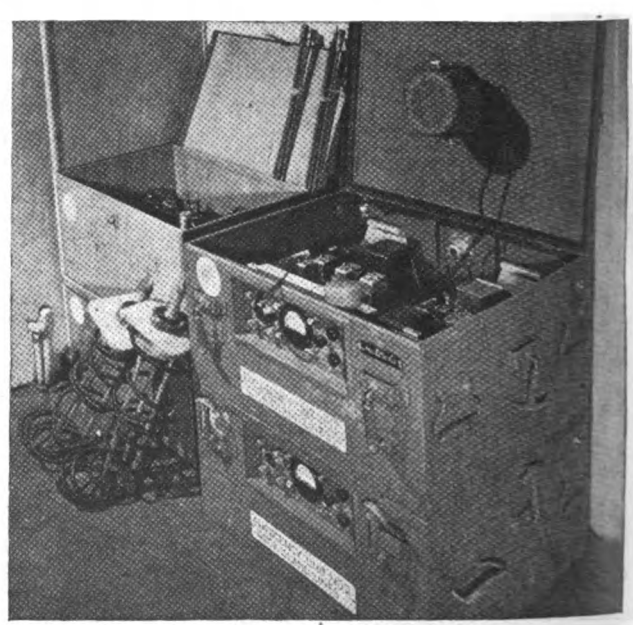
To Bridge Pole Line Breaks

Stored in a closet in this car are two self-contained, bridging, portable fixed, radio transmitter-receiver units. Designed by Rock Island and built by Galvin, these trunk-mounted bridging units and their associated automatic ringing devices are employed, when an extensive section of pole line is destroyed by a storm or flood, to maintain contact by combination of telephone or telegraph and radio. The end of the telephone or telegraph wire at the break is fed to one unit, and the message is radioed over the break (up to about 35 miles). It is received with the other radio unit and sent to its destination over the unbroken portion of the telephone or telegraph wires. To accomplish this, both bridging units are capable of "duplex" operation in that they transmit on one frequency and receive on another. The equipment can be powered from the car generator or from the regular 115-volt lines at any station. FM-type emission is used to avoid interference from the usual electric railroad and power line devices, and to give independence of atmospheric and static conditions.

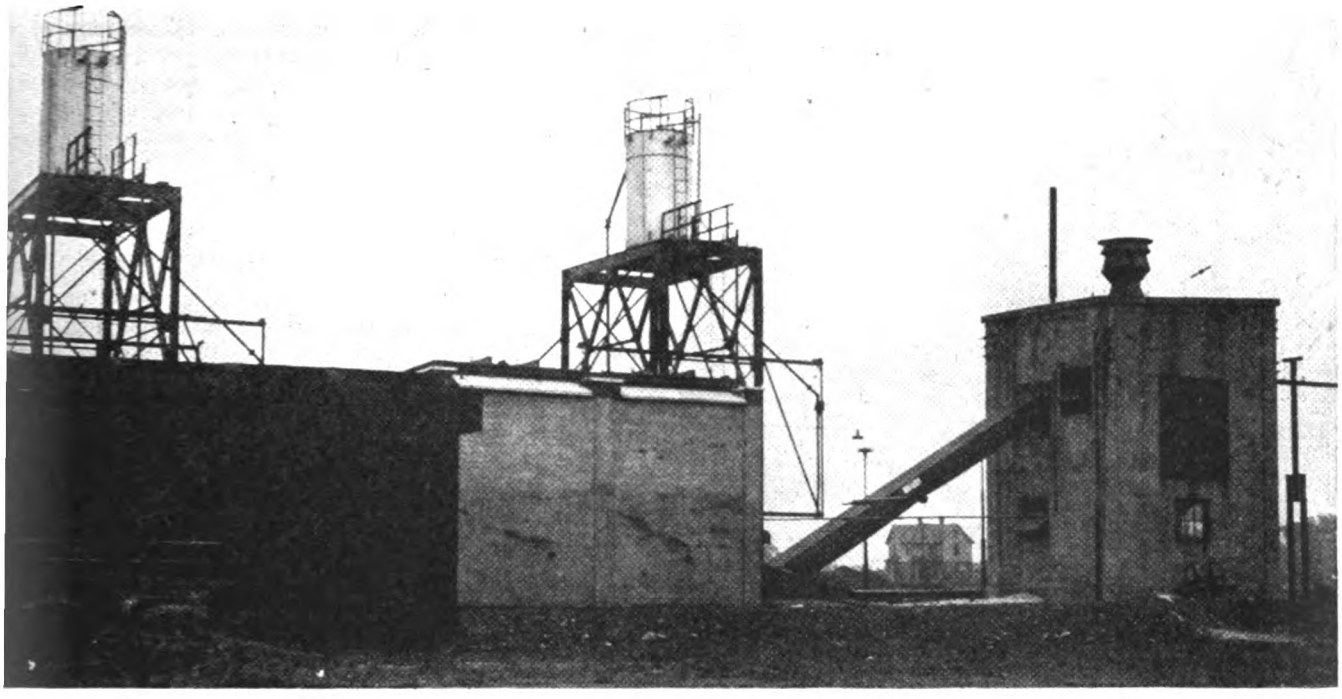
Special Antennae

The bridging units are used with special antenna base supports which enable the crew to install temporary aerials of the vertical rod type, on top of the nearest telegraph pole. A self supporting mast can also be created by pushing the base into the soft earth and mounting the vertical member. A permanently connected coaxial cable of correct length to match the impedance of the antenna to the equipment, is then joined to an outlet plug in the side of the portable trunk, closing the antenna circuit.

Radio installations were begun on Rock Island Lines under C. O. Ellis, superintendent of communications, and E. A. Dahl, electronic engineer, in March, 1944. The entire electronic field laboratory was developed and is under the supervision of Mr. Dahl. The laboratory and radio shop has given excellent service and has more than proven its worth in emergencies.



Portable radio sets for bridging pole-line breaks are mounted in two trunks



General view of the plant showing (left and center) wet sand storage, (right) sand drying building and (background) the two 20-ton sand towers which span the service tracks

Automatic Sand-Handling Plant

Electrical controls eliminate all manual operations between the wet-sand storage bin and the dry-sand discharge pipes

THE Erie has installed an entirely automatic sand-handling plant as a part of its Diesel-electric servicing facilities at Marion, Ohio. The automatic features are made possible by the use of electrical devices including photo-electric relays, pressure switches, electric vibrators, hopper level switches, etc.

A general view of the plant is shown in the largest photograph. In the center is a 70-ton wet storage bin which is loaded with a clam-shell crane through roof doors. At the left is a larger, open-top storage bin. At the right is the sand-drying building, and in the background are the two 20-ton dry-sand towers on structures which span the servicing track.

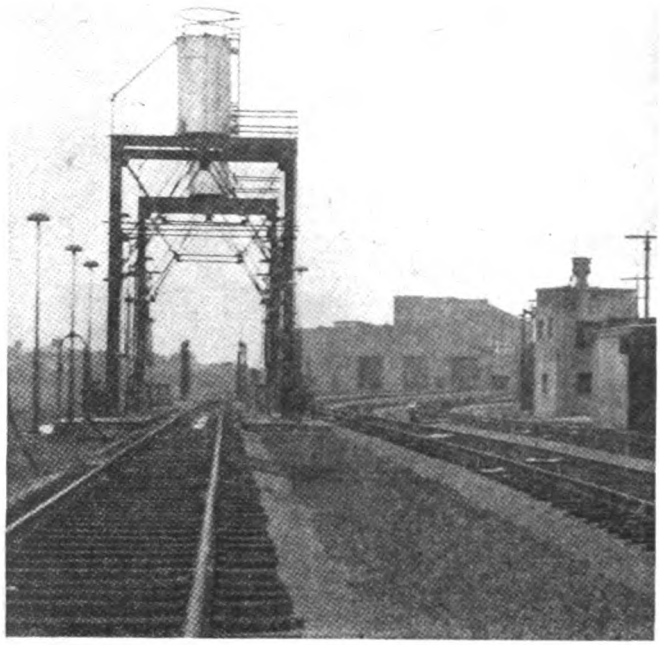
The sand in the wet storage bin is fed by gravity into chutes at the bottom of the bin. Directly under the chutes is a horizontal belt sand conveyor, 14 ft. long, driven by a three-hp. motor. The wet sand falls from one end of the horizontal conveyor onto a fast-moving inclined flight belt conveyor which carries the sand into an eight-ton storage hopper directly over two steam sand driers. The conveyor which is 40 ft. long is inclined at 30 deg. with the horizontal and is driven by a five-hp. motor. The conveyor motors are started by a push-button and are stopped automatically when the sand contacts a mercury-tube pendulum-type switch.

The steam coils under the eight-ton storage hopper are shown in the drawing. They are supplied with steam continuously and the condensate is used for locomotive cooling water and heating boilers. In the original design of the plant controls were included which shut off the steam when the demand for dry sand had been filled, but these were not included since wet sand would seep into the dry sand during off periods and very little steam is used when there is no sand movement since the water in the sand around the pipes has been removed and the sand itself provides effective heat insulation.

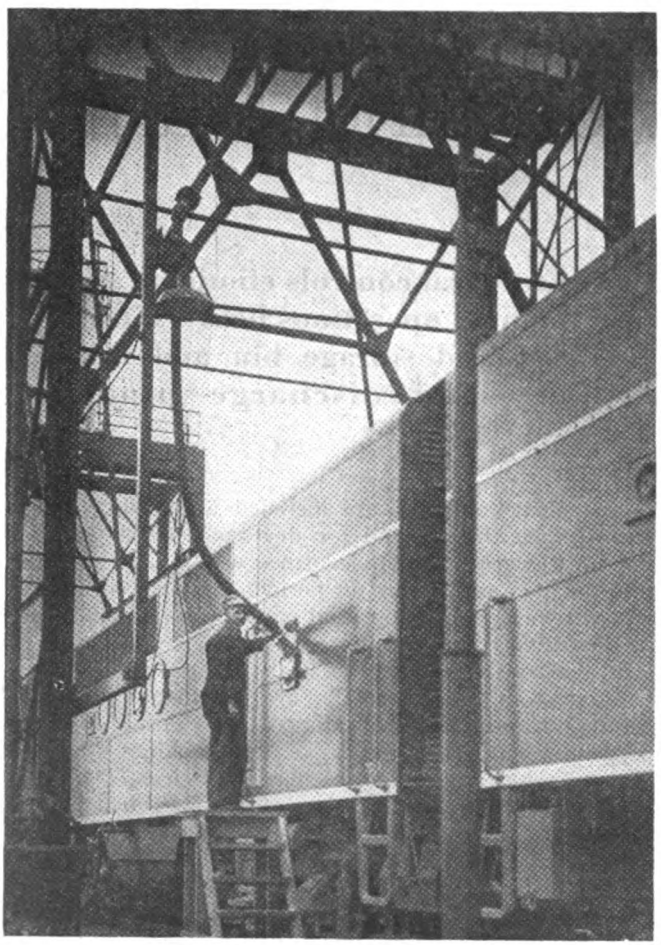
Sand from the drier falls by gravity as it is dried through two inclined vibrating screens into two cylindrical dry-sand elevating tanks, each holding 20 cu. ft. of sand per charge. Sand as needed is elevated by compressed air to the two 20-ton sand towers which span the service tracks and from which sand is fed into the locomotive sand boxes by gravity.

Photo-Electric and Pressure Switch Control

A feature of the elevating tank is its photo-electric control. At one side of each elevating tank is a by-pass or gauge pipe near the center of which are two glass windows or bull's-eyes. A light source opposite one of



The service track is shown at the left and the sand drier and storage bins at the right



A locomotive receives sand at the service track—Filling nozzles are arranged to supply all of the sand tanks on two units at one spotting of the locomotive—all of the fuel tanks can be filled from a single locomotive position.

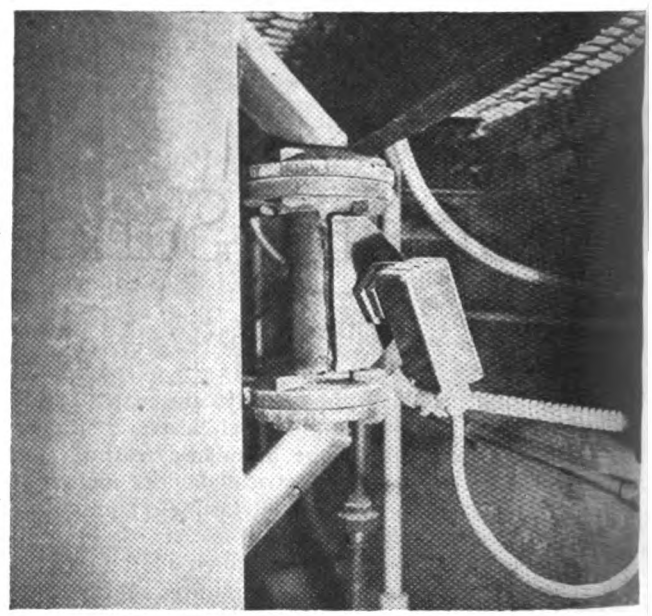
the bull-eyes shines through the pipe to a photo-electric relay when the pipe is empty. Under this condition the solenoid valve on the air line is closed.

The sand from the drier drains into the tank and when the tank is full, sand runs into the upper end of gauge pipe and blocks off the light passing through the bull's-eyes. This causes the photo-electric relay to function and this, in turn, opens the air valves and shuts down the screen vibrators.

Sand Elevated By Compressed Air

Air pressure in the tank first closes the plug valve through which the dry sand runs into the tank and then starts to discharge sand into the dry-sand tower. It requires 3½ min. to empty each drum.

When the elevating tank is empty, sand runs out of the gauge pipe, again exposing the photo-electric relay. In order to insure the complete emptying of the elevating tank and conveyor pipes at the end of each operation, there is installed a reverse operation pressure switch (52) set to close its contacts at about 25 lb. air pressure. These contacts shunt the contact made by the photo-electric relay and keeps air feeding into the elevating tank even after the sand has cleared out of the space



The photo-electric relay and light source are located on opposite sides of the elevating tank gauge pipe. When the tank is full, sand runs into the top of the gauge pipe filling the pipe and shutting off the light—when the tank is empty, sand runs out of the gauge pipe and exposes the relay to the light source

between the bull's eyes. As soon as all the sand is blown out of the conveyor pipes the air pressure falls rapidly in the elevating tank due to the large outlet in the tank and the air line being comparatively small, allowing the pressure switch to open and the solenoid valve closes shutting off the air. This cycle is repeated until the level of the sand in the sand tower is sufficient to open the upper hopper level switch, 58. The operation of the elevating tank is then discontinued until the level of the sand in the tower is low enough to allow both bin level switches to close.

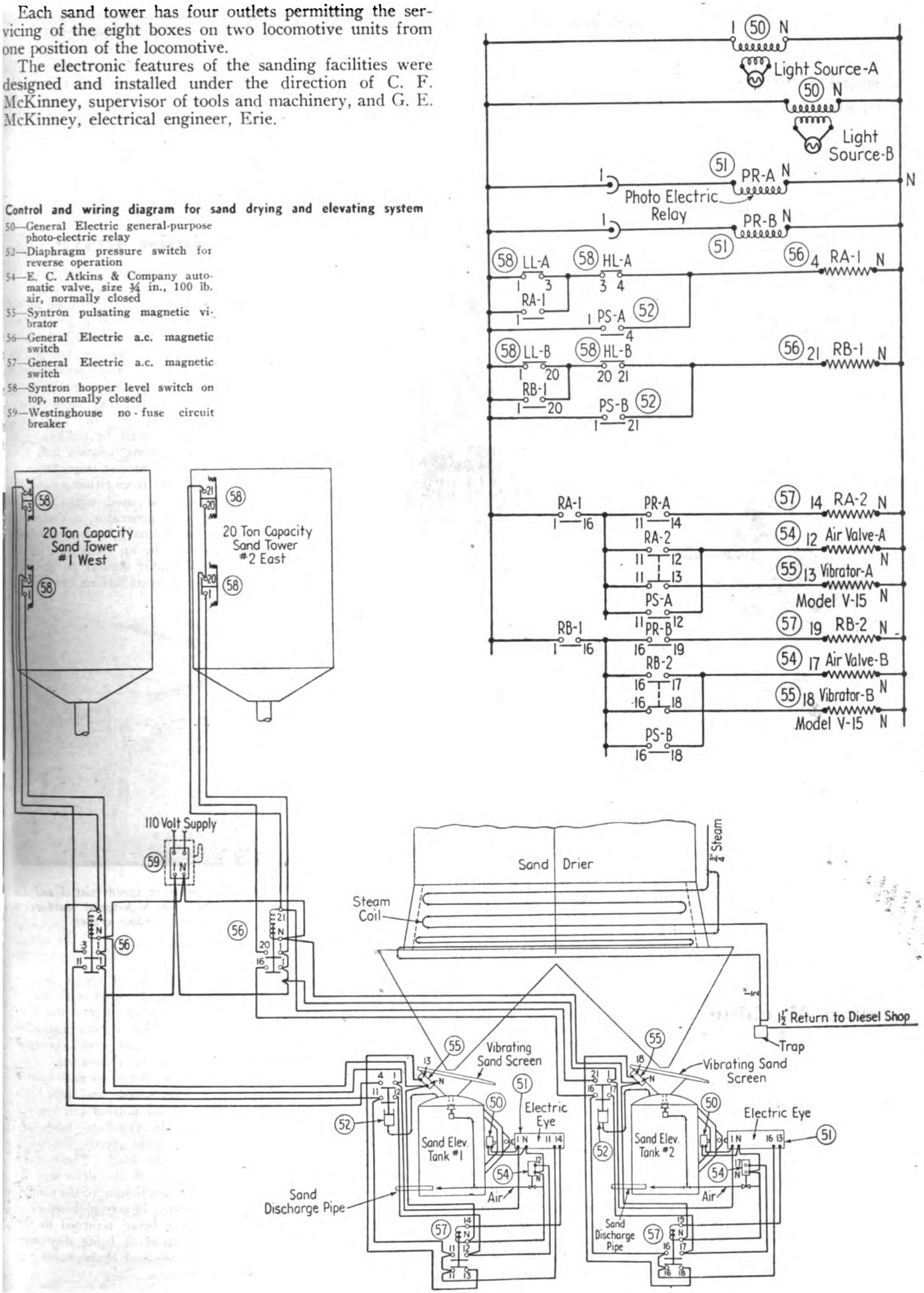
With no demand for sand from the dry sand tower, the sand from the drier fills the elevating tank and stops automatically because there is no place for it to go.

Each sand tower has four outlets permitting the servicing of the eight boxes on two locomotive units from one position of the locomotive.

The electronic features of the sanding facilities were designed and installed under the direction of C. F. McKinney, supervisor of tools and machinery, and G. E. McKinney, electrical engineer, Erie.

Control and wiring diagram for sand drying and elevating system

50—General Electric general-purpose photo-electric relay
52—Diaphragm pressure switch for reverse operation
54—E. C. Atkins & Company automatic valve, size ¾ in., 100 lb. air, normally closed
55—Syntron pulsating magnetic vibrator
56—General Electric a.c. magnetic switch
57—General Electric a.c. magnetic switch
58—Syntron hopper level switch on top, normally closed
59—Westinghouse no-fuse circuit breaker



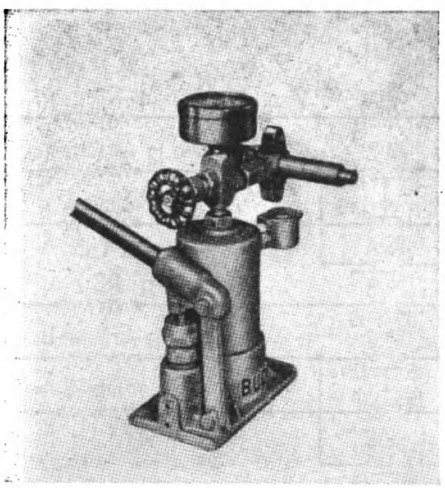
NEW DEVICES

Diesel Engine Nozzle Tester

A portable unit designed for testing Diesel engine nozzles and injectors has recently been introduced by the Buda Company, Harvey, Ill. The device functions so that any mechanic or Diesel-engine operator can measure injector opening pressures with it, determine accurate adjustment, check spray pattern for uniformity, and detect other irregularities such as sticking needle valves, dribble and leakage around valve seats.

The Buda universal Diesel nozzle tester is equipped with a standard hydraulic pressure gauge, with a $3\frac{11}{16}$-in. dial. Gauge capacity is 3,000 lb. per sq. in. and the dial has 100-lb. gradations. Gauges of 5,000 and 7,500 lb. capacity are also available.

Completely portable, the tester weighs



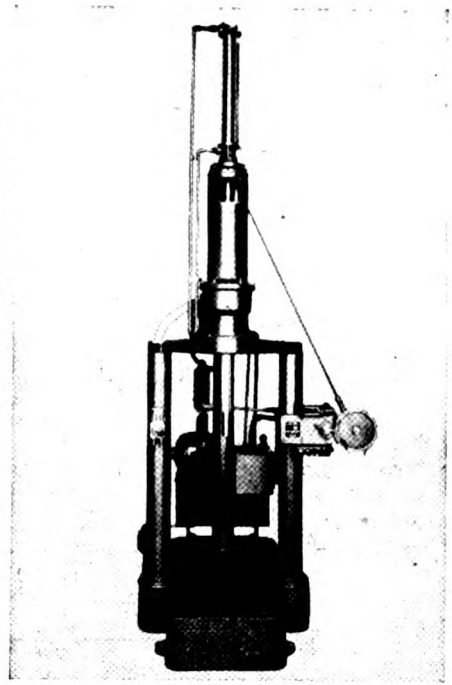
Universal Diesel-engine nozzle and injector tester

less than 19½ lb., including an all-steel carrying case, one adapter and a removable 12-in. steel handle. The carrying case is 5⅝ in. by 7½ in. by 11½ in. in size and holds such extras as adapter fittings, a special cradle, a popping device, extra pressure gauges, risers, a spray pan, high-pressure lines, fittings, etc.

Honing Machine

A honing machine, manufactured by the C. Allen Fulmer Company, 1237 First National Bank Building, Cincinnati 2, Ohio, is capable of honing cylinders of all diameters encountered in railroad operation. Among them are Diesel liners, gas-engine, air-pump, air-brake, stoker, reverse-gear, piston-valve and many other types of cylinders. It has been designed for heavy loads, continuous operation, and to deliver maximum torque into the spindle for fast stock removal. Spindle, gears and bearings are rugged and of large capacity for severe operation.

The machine can be supplied in various



Honing machine designed for heavy work

sizes with working strokes from 25 in. to 72 in., and with cylinder honing capacities up to 20 in. in bore. All the controls have been brought down to floor level by the use of a patented control system, and are located within easy reach of the operator at the front of the machine.

Spindle and shafts are of ample size, properly heat treated and mounted on oversize or roller or ball bearings, all operating in a bath of oil, which are adequately protected from dust and grit.

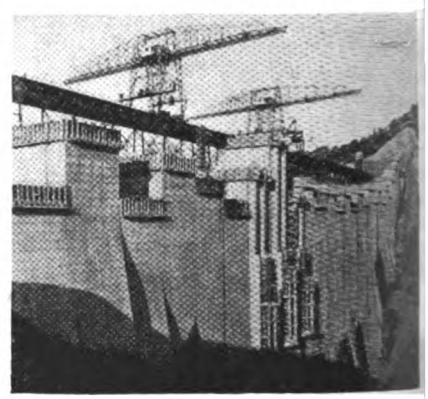
An ample supply of coolant is carried in the base of the machine and this passes through multiple settling chambers before being repumped to the work. A sump system permits cleaning the solid matter in the coolant system quickly without loss of coolant or productive time. For precise control and smooth operation, the entire reciprocating mass is hydraulically counterbalanced at all times.

The reciprocating spindle can be hydraulically stopped at any point within the stroke capacity of the machine without shock or impact to the machine or work. The spindle is locked in at such a stopping point and can be held there before upward movement, in definite second increments that are electrically timed. This timing range covers from one second to thirty seconds and the time is not affected by variations in oil temperature or viscosity, as would be the case with timing controlled by the hydraulic oil passing through an orifice of various sizes. When reciprocation is stopped, there is no pressure in the hydraulic pump line and the reciprocating mass is hydraulically sustained at that point in the stroke range. There is no over-run of the spindle at the top or bottom of the stroke at whatever reciprocating speed for which the machine may be set. This makes the machine very useful for honing blind-end cylinders, or up to an internal shoulder. There is no guess work on the setting of the controls, as they can always be re-set to obtain the same result, when a change-over of work is desired.

Crane Hoist Drive

A hoist drive for cranes, known as the Maxspeed system, has been announced by the Industrial Engineering Division of the General Electric Company. The drive, which automatically "measures" the load so that it is hoisted and lowered at the maximum safe speed and yet prevents the handling of dangerous overloads. It is designed for use on either indoor overhead, slow-speed cranes, or high-speed cranes of the type used in outdoor construction where accurate hoisting and lowering operation is of utmost importance.

The drive operates from either a.c. or d.c. incoming power. If used with a.c., the drive consists of a generator, a cross-flux exciter and an ordinary constant-voltage exciter, all driven by an induction motor, and a d.c. hoist motor similar to the type used in crane-hoist installations except that



The drive has inherent speed control and can be used either for high-speed outdoor or low-speed indoor cranes

its main field is designed for a variable separate excitation. If used with d.c., a shunt-wound d.c. motor drives the generator and the cross-flux exciter instead of an induction motor, and the constant-voltage exciter may be eliminated.

In operation, heavy loads are both hoisted and lowered at slow speeds, and light loads or the empty hook are hoisted and lowered at high speeds. Intermediate loads are handled at intermediate speeds, depending on the weight of the load. These speed changes are inherent in the drive and do not depend on the functioning of the control devices. All braking is accomplished electrically, the power being returned to the supply system instead of being dissipated in resistors. A solenoid brake holds the load when at rest.

Compression Tester For Diesel Engines

A portable instrument for checking Diesel-engine compression and firing pressures which has only one moving part has been developed by Kiene Diesel Accessories, Incorporated, 380 Lexington Avenue, New York 17, to answer the need for an easy method of making cylinder pressure tests. Operating instructions furnished with the

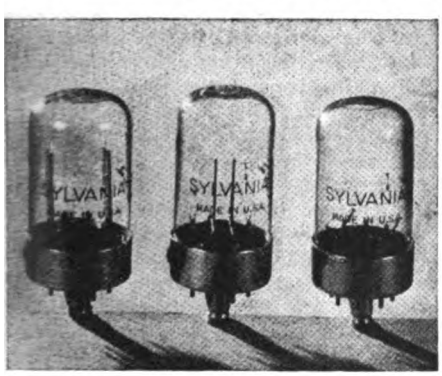
Compression checker for Diesel engines

instrument read, "Blow cock on working cylinder and attach indicator. Then open cock and read pressure on the high quality hydraulic gauge that is furnished with the instruments."

The device is equipped with a tapered plug and wing nut connector adaptable to standard indicator cocks. The reading on the gauge, when the device is connected to a cylinder, holds its indication until it is released by the oeprator. Frequent use of the indicator is a means of detecting minor abnormalities in operating conditions of a cylinder. It is not affected by heat and no complicated adjustments either before or during use.

Power Measurement Lamps

Simple, direct measurement of the power output of electronic and radio communication equipments at frequencies up to 900 mc. can be made by six types of power-measurement lamps developed by Sylvania Electric Products, Inc., Emporium, Pa. Built with two identical small filaments and mounted in lock-in type bases these lamps measure power outputs ranging between 0.05 and 25 watts with accuracies within five per cent or less, depending on the type of reading taken.

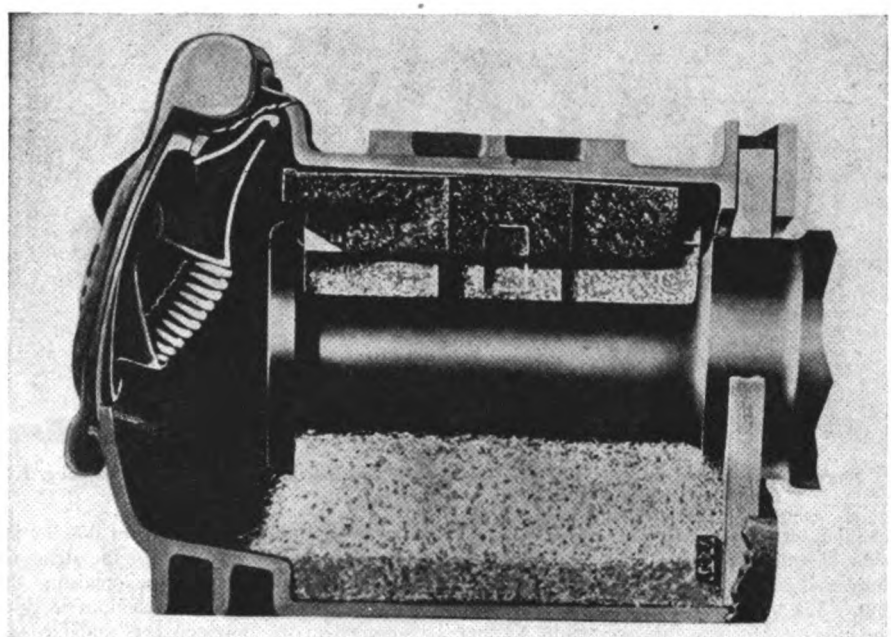


Three of six types of power measurement lamps for measuring high frequency radio power output

Power-output measurements are made by connecting one filament to the high-frequency output and the other to an a.c. or d.c. source. Voltage of the second filament is regulated until both filaments are equally bright. Power is determined by meter readings in the a.c. or d.c. circuit with equal power dissipated by the filament in the high-frequency circuit. Increased accuracy may be obtained by reversing the filament circuits and averaging results.

Journal-Box Lid Is Sealed Against Dirt

The National Malleable and Steel Castings Company, Cleveland 6, Ohio, has designed a journal-box lid with a dirt-deflecting strip, included as an integral feature. The lid is circular instead of square so that the lid face and the box mouth can both be machined if it is desired. About the edge of the box mouth is an upstanding flange, overlapping the edge of the lid, so that the lid, when closed, is recessed into the box. This, together with accurately fitted lid and box faces, provides for the exclusion of dirt and water under all conditions of weather and speed. The lid mechanism is of the National No. 3 coiled-spring type, in which the lid is pulled inward directly against the box mouth. The lid operating parts are all inside the box where they are continually lubricated. The lid and hinge lug are so designed that the lid is locked securely to the box without the use of a hinge pin. To remove or apply the lid a wedge is driven between it and the spring lever, no special tools being required.



Journal box arrangement showing tight-seal lid

25-Cycle Fluorescent Lighting

Electronic Laboratories, Indianapolis, Ind., has announced a flickerless fluorescent lighting system to be used on 25-cycle electric current. A conversion unit makes its use possible in areas where power is supplied at this frequency.

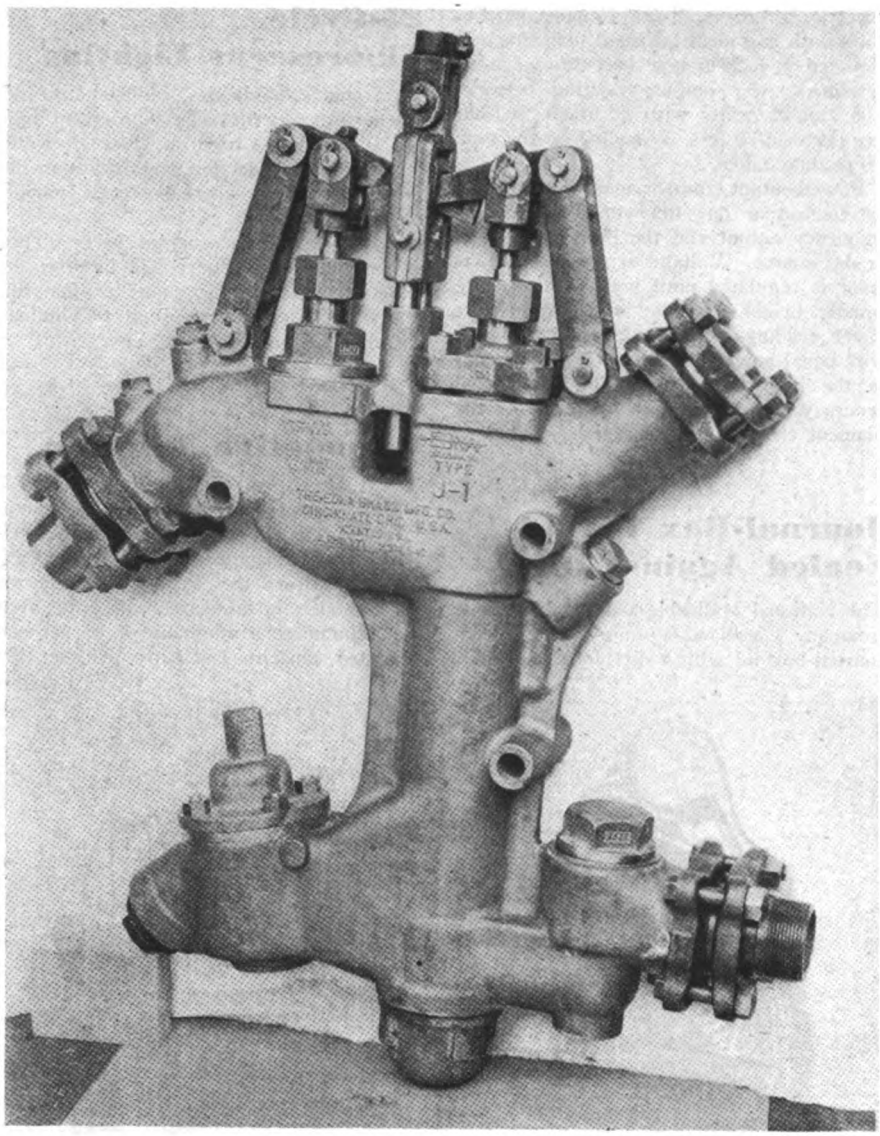
Twenty-five-cycle current gives a pronounced flicker in fluorescent lighting, and the conversion unit uses a rectifier tube and a voltage-doubler circuit to eliminate the flicker.

Locomotive Injector

The Edna Brass Company, Cincinnati 2, Ohio, has introduced a series of single-lever-operated injectors for locomotive use, which have capacities up to 15,000 gal. per hr. Known as the Type-J injectors, the three models in the series will grade from a maximum to a minimum of 65 per cent of rated capacity efficiently, without loss of water or steam. They will pick up feedwater having a temperature of 140 deg. F. and deliver water to the boiler at 300 deg. F. They will completely drain a tender and restart themselves if the steam or water supply is interrupted momentarily.

The single-lever mechanism permits maximum grading and ease of operation and makes positive the opening and closing of the water and steam valves at all times. The water valve always opens before the steam valve. The overflow arrangement on these injectors is fully automatic, but they are so arranged that they can be furnished with a combination automatic-manual control. If the single-lever control is not desired the injectors can be supplied equipped with a double-post cab stand, which permits manual control of the steam and water valves.

These injectors may be applied without



Single-lever-operated injector with a capacity of 15,000 gal. per hr. delivery at 300 deg. F.

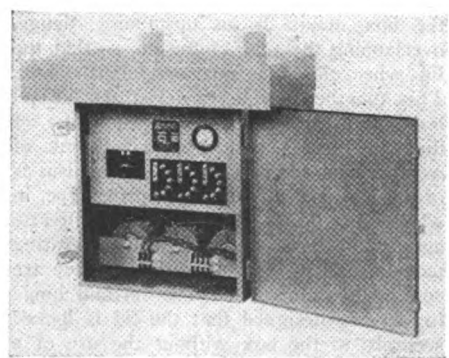
change on either the right- or left-hand side of the locomotive. The cab lever is universal and can be used for either mounting. The delivery-line check is built into the injector, but is readily accessible. Neither the injector nor the cab lever interfere with clear vision for the engineman. Provision is made for a connection for an alarm valve if the use of one is desired.

Cathodic Protection Rectifiers

Cathodic protection rectifiers, designed to reduce to a minimum the galvanic corrosion of underground metal structures, have been developed by Federal Telephone and Radio Corporation, Newark, N. J.

Buried structures, such as metal tanks, pipe-lines, well casings, lead-sheathed cables, conduits and similar installations are subject to chemical action between the metal and materials in the surrounding soil, capable of producing an electric current at the surface of the metal and causing galvanic corrosion, which will ultimately result in the destruction of the metal. The rectifiers counteract this current flow by introducing a potential between the structure and the soil in a direction opposing the galvanic current flow. A selenium rectifier contained in the unit converts standard alternating current power to continuous direct-current power.

The unit contains no moving parts and is effective over wide temperature ranges. It has small standby losses and is immune to momentary high overloads. A center-



The rectifiers are designed to protect buried metal structures from corrosion

contact method of construction is said to further insure reliability.

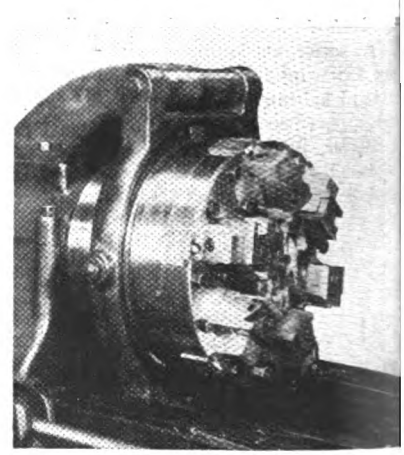
Suitable for installation indoors or out either on a wall or pole, the rectifier is contained in a weather-proof sheet-metal cabinet with drip-proof hood and hinged cover affording easy access to the control panel. Taps and links permit ready adjustment of the d.c. output which is indicated by an ammeter mounted on the control panel.

It is designed for operation on 230-volt 60-cycle, 3-phase power lines, to provide d.c. outputs up to 20 amp., from 10 to 40 volts continuous duty. The complete unit weighs 150 lb., and is 23 in. high by 25⅝ in. wide by 19¼ in. deep.

Die Head

The Landis Machine Company, Waynesboro, Pa., has as one of its postwar products the Lanco 4-in. semireceding six-chaser die head. It will have a capacity from 2½-in. to 4-in. pipe size, this range being covered by chaser holders mounted on slides of heavy cross section to assure maximum rigidity. The chaser holder slides are gibbed to the head body to provide compensation for wear. The interlocking design of the holder and slide assures a rigid clamping action of the two mating parts, with only one clamping screw.

The head employs the Lanrac chaser which provides an accurate and rapid

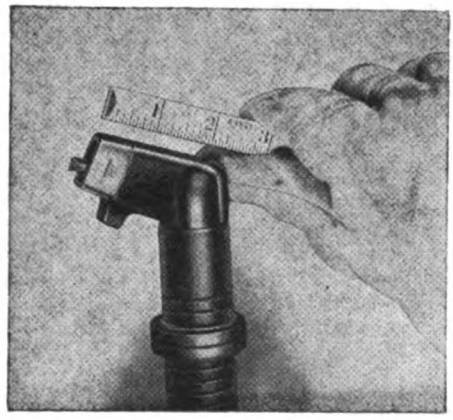


A six-chaser die head

method of interchanging and setting the chasers. This six-chaser die head is of the internal tripped type, in which a six-blade, insert-blade type reamer, located within the bore of the head, reams and chamfers the pipe during the threading operation and opens the head at any predetermined thread length. The semireceding action on the head eliminates the possibility of any chaser leave-off marks on the thread as the head opens up. The reamer is adjustable by an adjusting and clamping rod which extends through the machine spindle. Any desired thread length can be obtained by merely releasing the locking rod and turning the adjusting rod right hand or left hand to increase or decrease the thread length. Any thread length within the thread-length standards for 2½-in. to 4-in. pipe size is obtainable.

All parts of the Lanco six-chaser head are made from either high-carbon or special alloy steel, depending upon their function and are heat treated or case carburized and precision ground to assure maximum accuracy and long wearing quality. The head has remarkably few operating parts. All parts of this die head are thoroughly protected against wear. Zerk-type fittings provide a means of forcing heavy grease into the chaser slides and other operating parts for lubricating purposes and also to act as a seal to prevent entry of fine cuttings and dirt to assure maximum life.

While the die head is designed primarily to operate as an internally tripped unit, it can be opened and closed externally by means of an operating yoke.

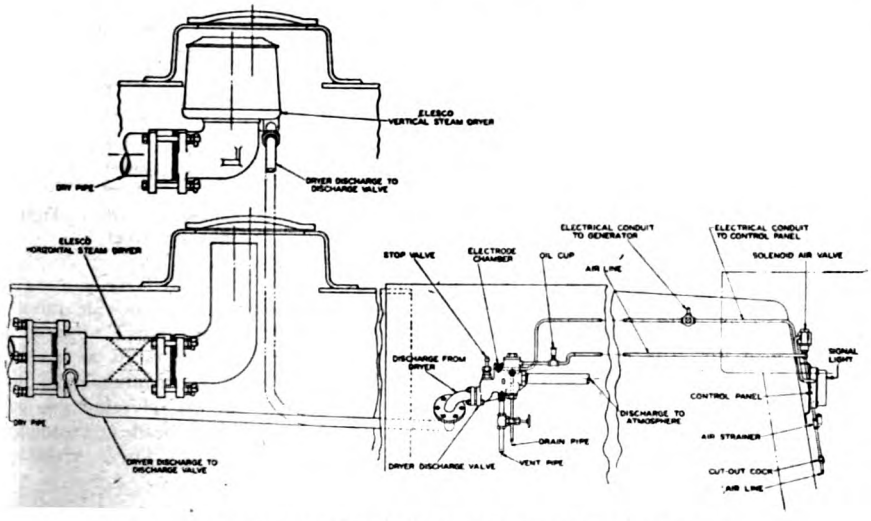


Maximum burn off on electrodes is possible with this holder

holder jaw. An extension of the holder itself allows the now usable stub end of the rod to be projected into the proper position for welding. The holder is completely insulated and loads and unloads in a second. Operator fatigue is said to be reduced because of its good balance and light weight.

Steam Drive Has Automatic Discharge

The carry-over of water and solids with the steam in locomotive operation is discharged by an automatic valve introduced into the Elesco Steam Dryer System by the Superheater Company, New York 17. Tests of applications have disclosed that a heavy carry-over of water, which would otherwise have entered the superheater, is ejected to the ground. Normal steam temperatures are maintained with protection to superheater units, throttle valves, valve and cylinder rings. The valve is automatic in operation.

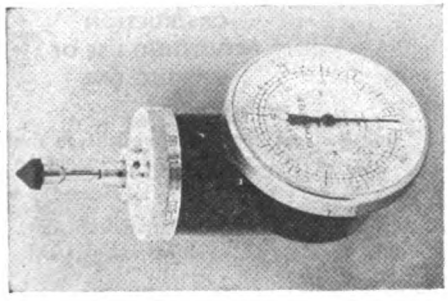


Arrangement of automatic discharge valve in steam dryer system

Precision Tachometer

James G. Biddle Co., Philadelphia, Pa., has announced a precision direct-indicating hand tachometer having two scales and five different ranges: 45 to 180, 150 to 600, 450 to 1,800, 1,500 to 6,000, and 4,500 to 18,000 r.p.m.

Change of range is made by rotation of a knurled barrel head. The instrument is supplied complete with carrying case and accessories, including a six-inch circumference wheel for measuring surface speeds.



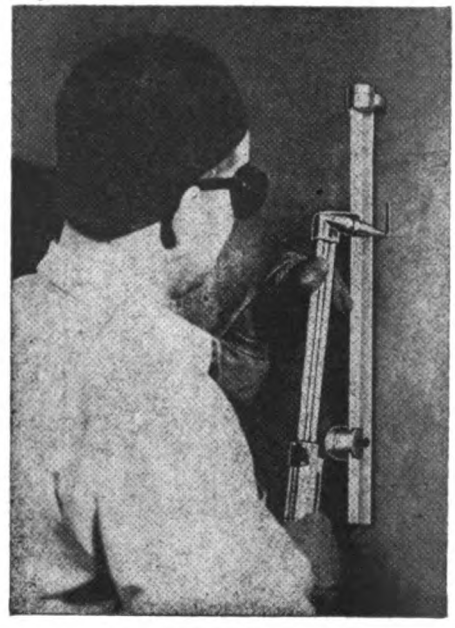
The tachometer has two scales and five ranges

Electrode Holder

An electrode holder, designed to allow unobstructed visibility while welding and maximum accessibility even for deep pocket work, fast loading and reloading, and a more complete using up of electrodes has been announced by the Hollup Corporation of Chicago, a division of the National Cylinder Gas Company. Electrodes can be used to a point right up to the uncoated end of the rod. Only one-half inch is needed for a tight, efficient current contact in the

Magnetic Straight Edge

Flame-cutting of vertical and overhead as well as horizontal surfaces, is said to be greatly facilitated by the use of magnetic straight edges, according to the manufacturers. The B & W Company, 7610 So. Figueroa street, Los Angeles 13, Calif. An 18-lb. pull holds the B & W magnetic straight edge firmly to the work even if the plate is rusted, oily or painted. Alnico magnets, which are not affected by electricity, are said to last for years.



Flame-cutting a vertical surface using a magnetic straight-edge guide

Uniformly clean and accurate cuts are obtained because the torch tip is held at the correct distance from the work. The straight edges are easily adjustable to any bevel angle. Bevels are cut in one operation. Made of a specially heat-treated aluminum alloy, rigid as well as light in weight, the straight edges do not warp from heat and are resistant to corrosion. Three models are offered in lengths from 18 to 36 in.

Voltage Control-Relay for A.C. Welders

The Pullman-Standard Car Manufacturing Company, Chicago, has announced a safety panel for eliminating the hazard of high, open-circuit voltages on a.c. welders. The device functions so that when welding contact is broken, it automatically reduces the open-circuit voltage on the electrode from 110 to 24. The manufacturer states that not only does the panel eliminate the hazard but also contributes materially

to the ease of mind of the operator. The control panels have been installed in all of the Pullman-Standard plants and are available to other manufacturers through an arrangement with the Square D Company, Detroit, Mich.

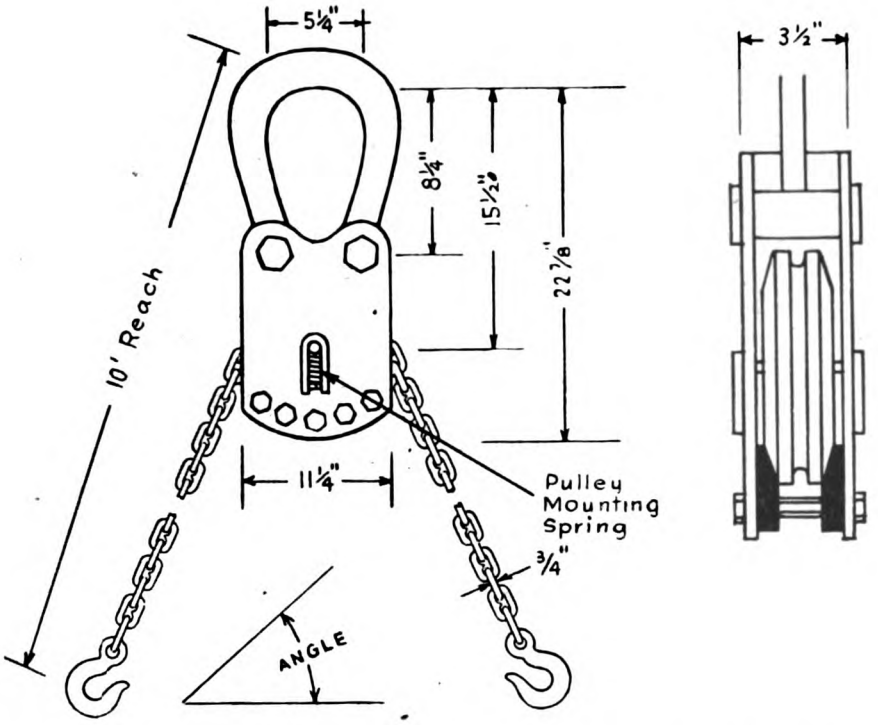
Self-Leveling Sling

The Hercules Sling Company, Rockford, Ill., has introduced a complete line of Safe-T-Lift automatically equalizing chain slings made in 4-ton, 7-ton, 14-ton, 25-ton and 40-ton capacities. Recent tests of the 7-ton sling by Robert W. Hunt Co. showed the newly developed chain sling to have a safety factor of 4¼, or a capacity to carry 4¼ times the nominal design load.

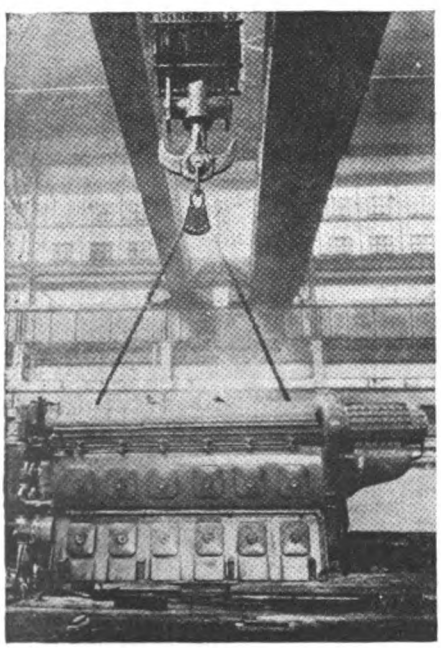
Operation of the Safe-T-Lift sling is simple. The block or chain equalizer unit is placed on the crane hook and the crane operator spots the hook over the approximate center of gravity of the load. Floormen then attach the sling's chain legs to the load.

Power to lift the load is applied by the crane operator, and as the crane hook rises the sling's chain automatically adjusts itself weight of the load pulls on the chain, the sheave in the equalizing unit pulls down against a brake, preventing slippage. Level lifting of the load is assured.

If the crane operator does not get the crane hook and equalizing unit close enough to the load's center of gravity, the load is lowered enough to relieve tension on the sling and release the brake. The crane hook is then moved over to the true center of gravity, and when power is applied the chain readjusts for level lifting.



Details of construction of the 14-ton Safe-T-Lift automatic-equalizing chain sling illustrated below which is used in the level carrying of an unbalanced 13-ton Diesel engine at a railroad repair shop

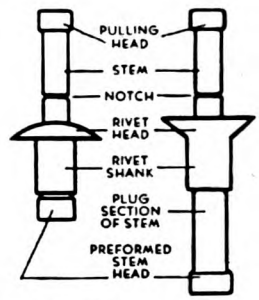


through the Safe-T-Lift equalizing unit. The unit consists of a sturdy steel block and a floating sheave specially constructed to fit the steel alloy chain.

When loads are lifted, one chain leg becomes longer than the other and as the

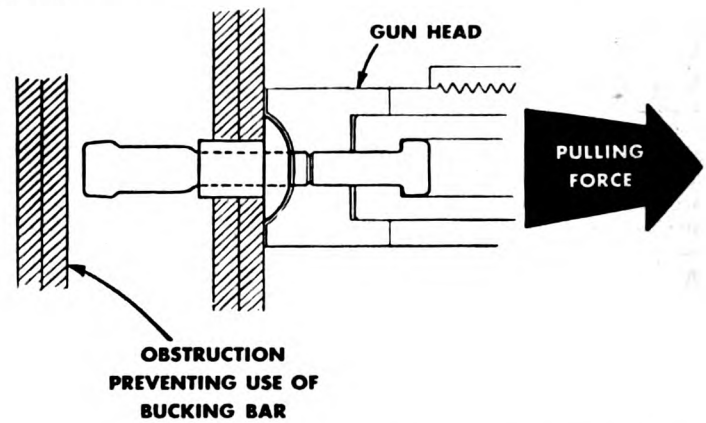
One-Man Riveting

Originally designed to solve the problem of riveting in blind locations where it was not possible to buck up an ordinary rivet, the Cherry rivet, manufactured by the Cherry Rivet Company, Los Angeles, Calif.,



Left: A regular hollow-type rivet—Right: A self-plugging rivet

has been found to have a wide range of uses in other applications. Briefly described, the rivet consists of an assembly of two parts, a hollow member and a stem. The action of a special riveting gun pulls the stem into a blind head and completes the rivet installation. These rivets are



One man can apply this special-type rivet intended for use where a bucking bar cannot be employed

available in a variety of types, diameters, grip lengths and alloys, intended to meet practically any industrial application where their use is indicated. They may be used on a wide range of pliable and brittle materials, as well as on all sheet metals.

(*Turn to second left-hand page*)

to make a good wheel *Better*

AMCCW members 1945

- American Car & Foundry Company
- Canadian Car & Foundry Company, Ltd.
- Cleveland Production Company
- Griffin Wheel Company
- Marshall Car Wheel & Foundry Company
- Maryland Car Wheel Company
- Mt. Vernon Car Manufacturing Company
- New York Car Wheel Company
- Pullman-Standard Car Manufacturing Company
- Southern Wheel Division, American Brake Shoe Company
- The Tredegar Company

. . . they spend their time and money

This list of AMCCW members should interest every progressive railroad man. One good reason: it's a rollcall of firms giving top priority to the interests of the railroad industry.

Seeking without pause to make a good chilled car wheel better . . . spending long careful man-hours in protective testing . . . allocating dollars without stint to laboratory maintenance, these member companies unhesitatingly place service and improved product first.

It is a condition of good AMCCW standing that such policies command strict adherence. That is why the work of Association inspectors gets every cooperation from every member . . . why Association research and new product development work gets firm support all down the membership line. In the long run, it may well prove to be a sound reason why wartime peaks in freight car performance are establishing all-time records, when needed most.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE, NEW YORK 17, N. Y. • 445 NORTH SACRAMENTO BOULEVARD, CHICAGO 12, ILL.

Organized To Achieve: Uniform Specifications — Uniform Inspection — Uniform Product

4195

TO SPEED THE

RECOVERY OF FRANCE

LIMA DELIVERS THE FIRST OF 700 STEAM LOCOMOTIVES BEING BUILT IN AMERICA

In the war wreckage of the French railways five out of six of her locomotives were destroyed, and to restore normal life in France her transportation system must be rehabilitated as quickly as possible.

America has been called upon to meet the desperate need for motive power and seven hundred 2-8-2 steam locomotives have been ordered here, of which 180 are being built by Lima.

Realizing the vital importance to France of these locomotives, Lima is meeting the emergency by building its

share in record time. The first of any of the seven hundred to be completed was turned over to representatives of the French Supply Mission on July 31, after being christened the "Liberation" at a ceremony at the Lima Works.

LIMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

NEWS

An "Atomic" Locomotive?

RALPH LUCAS of the United States Industrial Research & Development Co., of Elmira, N. Y., on September 11, told reporters for the daily newspapers at Newark, N. J., that laboratory tests he had made had succeeded in releasing atomic energy from mercury in a manner adaptable for use as a source of energy for locomotive propulsion; and that the New York Central had expressed an interest in his experiments. He added that he expected to have N. Y. C. cooperation, enabling him to install his mechanism in a locomotive of that company for test purposes.

The railroad has neither confirmed nor denied this report, declining at this time to make a statement of its negotiations with Mr. Lucas, if any.

Orders for New Equipment on Books as of August 1

Freight Cars—As of August 1 there was a backlog of 34,797 freight cars on order and undelivered for domestic service. Of these, 32,682 were ordered by 51 railroads, 1,815 by private-car lines and industrial companies, and 300 by government agencies. Railroad orders comprised 20,340 box, 5,332 hopper, 5,738 gondola, 850 flat, 89 dump, 50 pulpwood, three refrigerator and 280 caboose cars. The total orders were allocated 25,113 to contract car builders and 9,684 to company shops.

Passenger-Train Cars—As of August 1, 1945, there was a backlog of 1,155 passenger-train cars on order for domestic railroads, which number was almost equal to four years' average production during the twelve years preceding the war, 1930-41, inclusive. Deliveries on these cars were scheduled to begin in August. Included were 696 coaches, 8 multiple-unit coaches, 45 coach combinations, 18 club-parlor-lounge-observation cars, 38 baggage-express, 129 sleeping, 126 dining, 51 postal cars, and 43 additional cars, the types of which are unknown. Excepting 10 cars for the Long Island and 90 for the Pennsylvania ordered from the latter's shops, the remaining 1,055 cars are scheduled for building in contract shops.

Thirty-six Hour Week Asked by Shop Craft Unions

THE seven railway shop craft unions have announced that they will seek a six-hour day, six-weekday work week from the railways with no reduction in pay, according to a statement by William Jewell, president of the Railway Employees Department of the American Federation of Labor. The decision to seek a shorter work week was reached after a three-day conference of general chairmen, meeting in Chicago on September 12, 13 and 14.

Mr. Jewell said that the railroads "will be requested to agree to establish a six-hour day, six week-days a calendar week, without reduction in present straight-time weekly compensation, instead of the present eight-hour day, six week days a calendar week." He stated that no changes in working rules would be sought other than those needed to make the requested shorter work-week effective.

The seven co-operating unions will file formal notice upon the carriers on September 25, according to Mr. Jewell, who added that a detailed public statement explaining the reasons for the request would be issued shortly. The group, of which he is president, represents 400,000 railway employees and has contracts on all of the nation's major rail carriers except the Pennsylvania and Western Maryland, he said.

The organizations filing the demand are: The International Association of Machinists; the International Brotherhood of Boilermakers; Iron Shipbuilders and Helpers of America; the International Brotherhood of Blacksmith, Drop Forgers and Helpers; the Sheet Metal Workers International Association; the International Brotherhood of Electrical Workers; the Brotherhood of Railway Carmen of America and the International Brotherhood of Firemen, Oilers, Helpers, Roundhouse and Railway Shop Laborers.

Railroads Now Have 3,202 Diesel Locomotives in Service

ACCORDING to statistics compiled by the *Railway Age*, there were 3,202 Diesel locomotives in service on domestic railways as of June 30, 1945, including 2,791 owned by Class I railways (excluding terminal and switching companies) and 411 owned by terminal and switching companies and Class II and III roads. Class I roads were operating 642 Diesel road locomotives having a total of 2,047,590 hp. and 2,149 switchers with a total of 1,725,038 hp.

There were 271 Diesel locomotives installed during the first six months of 1945, including 25 5,400-hp., five 4,050-hp. and 21 2,700-hp. freight locomotives; 81 2,000-hp. passenger and combination passenger and freight locomotives and 139 switchers averaging 824 hp. The distribution by horsepower of Diesel locomotives on Class I railroads as of June 30, 1945, is shown in the accompanying table.

B. & O. Orders Radio-Telephone for New Castle, Pa., Yard

AN order for radio-telephone equipment believed to be the first from any railroad for equipment of very-high frequency, has been placed with the Bendix Radio division of the Bendix Aviation Corporation by the Baltimore & Ohio for use in its yard at New Castle, Pa. It will facilitate the operation of the freight classification yard at that point.

The B. & O. first tested low-frequency radio-telephone equipment in 1928, and in July of last year, in cooperation with Bendix, made its first test of high-frequency radio telephone equipment in its Baltimore terminals. At that time, A. S. Hunt, now chief engineer of communications and signals, reported the test was so satisfactory he expected to arrange for a permanent installation as soon as conditions permitted.

The equipment to be installed at New Castle will consist of a fixed radio transmitter and receiver, and of mobile transmitter receiving units installed on switching engines, and will have three main control points so the yard office may be in constant radio communication with the crews in charge of engines switching the trains. This, it is said, will not only expedite switching under normal conditions but will also be of special value when the weather is adverse and hand signals are not easily visible. The transmitters will broadcast under specific wave length in the 156-162 megacycle range under license issued by the Federal Communications Commission.

It is expected the installation at New Castle may further prove the practicability of radio-telephone for railroad use, and that gradually it will be expanded for use on moving trains in main-line service.

New Shop Projects

New York, New Haven & Hartford.—The Federal district court at New Haven, Conn., has approved the expenditure of $675,000 for the construction and equipping of a new Diesel locomotive maintenance

(Continued on next left-hand page)

Diesel Locomotives in Service on Class I Railways—June 30, 1945

Horsepower	Freight locomotives No.	Freight locomotives Total hp.	Passenger and comb. pass. and frt. locomotives No.	Passenger and comb. pass. and frt. locomotives Total hp.	Total no. locomotives	Hp., total
5,400	216	1,166,400	11	59,400	227	1,225,800
4,050	6	24,300	1	4,050	7	28,350
3,600	..	.....	2	7,200	2	7,200
2,700	25	67,500	10	27,000	35	94,500
2,000	..	.....	301	602,000	301	602,000
1,800	..	.....	31	55,800	31	55,800
1,200	..	.....	7	8,400	7	8,400
1,000	8	8,000	14	14,000	22	22,000
380	8	3,040	..	.....	8	3,040
Under 380	2	500	..	.....	2	500
Total road locos.	265	1,269,740	377	777,850	642	2,047,590
Switching locos.	(Average 803 hp. per locomotive)				2,149	1,725,038
Total rd. and sw. locos.					2,791	3,772,628

Note:—411 Diesel locomotives of 286,660 total horsepower are estimated to be in service on switching and terminal companies and on Class II and III railroads.

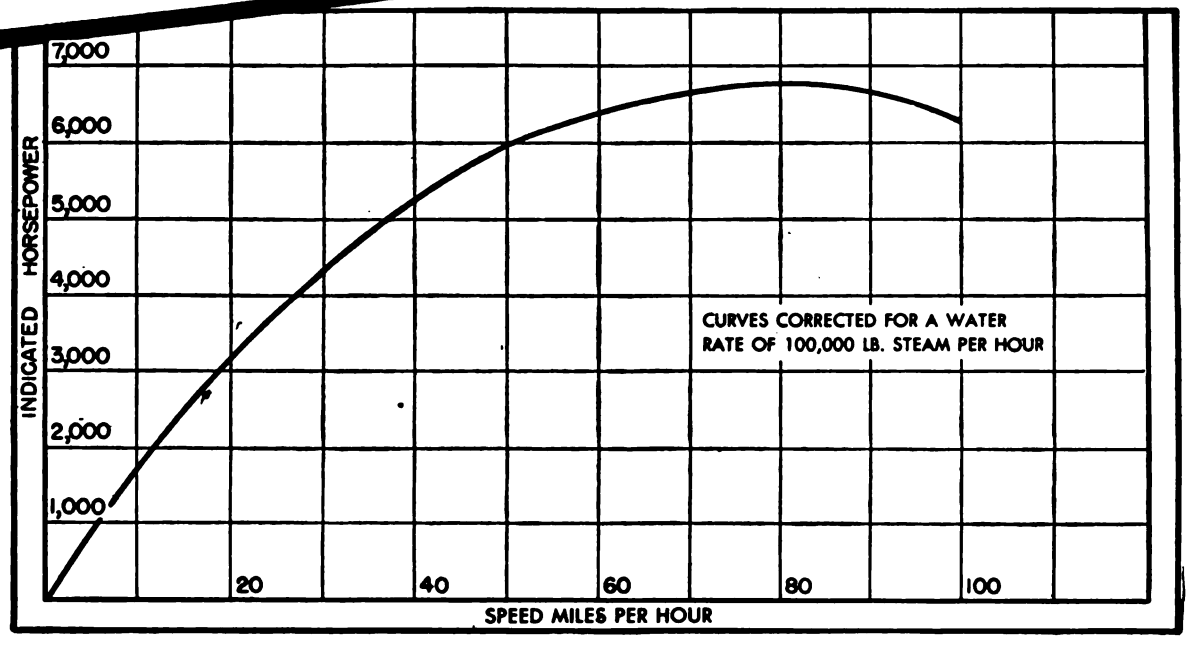
6552 INDICATED HORSEPOWER

The Franklin System of Steam Distribution

applied to

The Pennsylvania Railroad's

T-1 Locomotives



Ralph P. Johnson, Chief Engineer of the Baldwin Locomotive Works says:

"The maximum indicated horsepower of the T-1 locomotive is 40 percent higher than that of any locomotive previously tested at Altoona. The graph shows the maximum indicated horsepower of the T-1 locomotive at various speeds, based on a steam supply of 100,000 pounds per hour."

From paper read before the New York Railroad Club on May 17, 1945.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO

In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

shop for the New Haven at New Haven, Conn. The road needs a centrally located Diesel shop to supplement repair and maintenance shops at Boston, Mass., and New York and to care for the large number of Diesel units operated in the New Haven area. The new shop will handle periodical inspection and maintenance of Diesel switchers, as well as running repair work on road locomotives. Special features will include an overhead traveling crane, full length inspection pits, high speed locomotive jacks, a drop table, and an overhead inspection platform. Small individual shops for the repair of electrical air brake, and signal equipment will complement the main shop. Modern locker room and washroom facilities will be provided.

Pere Marquette.—The Pere Marquette has awarded a contract, amounting to $90,000 to L. D. Strandberg & Son, Chicago, for the construction of a two-stall Diesel enginehouse at Chicago.

Susquehanna Completes Dieselization

THE New York, Susquehanna & Western has received delivery of the last of a fleet of 16 1,000-hp. Diesel-electric locomotives built by the American Locomotive Company and the General Electric Company. These 16 Diesel units replace 32 steam locomotives and effect complete Dieselization of the railroad.

Based on actual costs in 1944, conversion to all Diesel-electric operation is reported to be producing savings at the rate of more than $400,000 a year. Maintenance and depreciation on 75 coal cars no longer required and maintenance of way and structures expenses, allowing for new Diesel-electric facilities, have been reduced to effect a saving of approximately $19,000 a year. The operating cost of the new units on passenger runs is reported to be 49 cents per locomotive-mile as compared to $1 per locomotive-mile for the steam engines. In addition, in 1945 the 16 units will handle an estimated 113,000,000 freight-ton-miles at an operating cost of 60 cents per locomotive-mile against $1.14 per locomotive-mile for the steam engines. Performing 6,575 hours of yard service annually, the Diesels are reported to be saving more than $20,000 a year over the operating cost of the steam engines in this service.

Directory

The following list gives names of secretaries, dates of next regular meetings, and places of meetings of mechanical associations and railroad clubs:

ALLIED RAILWAY SUPPLY ASSOCIATION.—J. F. Gettrust, P. O. Box 5522, Chicago.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—H. H. Henline, 33 West Thirty-ninth street, New York 18.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. C. E. Davies, 29 West Thirty-ninth street, New York 18.

RAILROAD DIVISION.—E. L. Woodward *Railway Mechanical Engineer*, 105 West Adams street, **Chicago 3.**

ANTHRACITE VALLEY CAR FOREMEN'S ASSOCIATION.—O. R. Highfield, 74 Roosevelt Terrace, Wilkes-Barre, **Pa. Meets January,** March, May and November at Scranton, Pa. February, April, October and December at Wilkes-Barre, Pa.

ASSOCIATION OF AMERICAN RAILROADS.—Charles H. Buford, vice-president Operations and Maintenance Department, Transportation Building, Washington 6, D. C.

OPERATING SECTION.—J. C. Caviston, 30 Vesey street, New York 7.

MECHANICAL DIVISION.—A. C. Browning, 59 East Van Buren street, Chicago 5.

PURCHASES AND STORES DIVISION.—W. J. Farrell, Executive Vice Chairman, Transportation Building, Washington 6, D. C.

MOTOR TRANSPORT DIVISION.—George M. Campbell, Transportation Building, Washington 6, D. C.

CANADIAN RAILWAY CLUB.—R. C. Crook, 4415 Marcil avenue, N. D. G., Montreal, Que. **Regular meetings, second Monday** of each month, except June, July and August, at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT ASSOCIATION OF ST. LOUIS.—J. J. Sheehan 1101 Missouri Pacific Bldg., St. Louis, Mo. Regular monthly meetings third Tuesday of each month, except June, July, and August, DeSoto Hotel, St. Louis.

CAR DEPARTMENT OFFICERS ASSOCIATION.—J. H. Stremmel, 6536 Oxford avenue, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Ralph J. Feddor, 2803 North Campbell avenue, Chicago. Regular meetings, second Monday in each month, except June, July and August, La Salle Hotel, Chicago.

CAR FOREMEN'S ASSOCIATION OF OMAHA, COUNCIL BLUFFS AND SOUTH OMAHA INTERCHANGE.—H. E. Moran, Chicago Great Western, Council Bluffs, Ia. Regular meetings, second Thursday of each month.

CENTRAL RAILWAY CLUB OF BUFFALO.—R. E. Mann, Room 1840-2, Hotel Statler, Buffalo, N. Y. Regular meetings, second Thursday of each month, except June, July and August, at Hotel Statler, Buffalo.

EASTERN CAR FOREMEN'S ASSOCIATION.—W. P. Dizard, 30 Church street, New York 7. Regular meetings ,second Friday of January, February, March, April, May, October, and November at Engineering Societies Bldg., 29 West Thirty-ninth street, New York 18.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—Roy Ent, A. A. R., clerk P. & E., Big Four building, Indianapolis, Ind. Regular meetings, first Monday of each month, except July, August and September, in Indianapolis Union Station, Indianapolis, at 7 p. m.

LOCOMOTIVE MAINTENANCE OFFICERS' ASSOCIATION.—C. M. Lipscomb, 1721 Parker St., North Little Rock, Ark.

MASTER BOILER MAKERS' ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany 3, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meetings, second Tuesday in each month, except June, July, August and September, at Hotel Vendome, Boston, Mass.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York 7. Meetings, third Thursday in each month, except June, July, August, September and December, at 29 West Thirty-ninth street, New York 18.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meetings first Monday each month, except June, July and August, at Midway Club rooms, 1931 University avenue, St. Paul.

NORTHWEST LOCOMOTIVE ASSOCIATION.—G. T. Cardell, 820 Northern Pacific Building, St. Paul, Minn. Meetings third Monday of each month, except June, July and August.

PACIFIC RAILWAY CLUB.—William S. Wollner, P. O. Box 458, San Rafael, Calif. Regular meetings, second Thursday of each alternate month at Palace Hotel, San Francisco, Calif., and Biltmore Hotel, Los Angeles.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 308 Keenan Building, Pittsburgh, Pa. Regular meetings, fourth Thursday in month except June, July and August, Fort Pitt Hotel, Pittsburgh, Pa.

RAILWAY FUEL AND TRAVELING ENGINEERS' ASSOCIATION.—T. Duff Smith, Room 811, Utilities Building, 327 South La Salle street, Chicago.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 308 Keenan Building, Pittsburgh, Pa.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, Box 120 S, Atlanta, Ga. Regular meetings, third Thursday in January, March, May, July and September. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

TORONTO RAILWAY CLUB.—D. M. George, Box 8, Terminal A, Toronto, Ont. Meetings, fourth Monday of each month, except June, July, and August, at Royal York Hotel, Toronto.

WESTERN RAILWAY CLUB.—E. E. Thulin, executive secretary, Suite 339 Hotel Sherman, Chicago. Regular meetings third Monday in each month, except June, July, August, September, December, and January, Hotel Sherman, Chicago.

Orders and Inquiries for New Equipment Placed Since the Closing of the September Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Chicago, Burlington & Quincy	10	4,000-hp. Diesel elec. pass.	Electro-Motive

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Baltimore & Ohio	350	70-ton covered hopper	American Car & Fdry.
Chesapeake & Ohio	1,500[1]	50-ton hopper coal	American Car & Fdry.
	500	50-ton hopper coal	General American
	200	70-ton covered hopper	General American
Denver & Rio Grande Western	200	70-ton ballast	American Car & Fdry.
Missouri-Kansas-Texas	50	70-ton covered hopper	American Car & Fdry.
Texas & Pacific	25	70-ton covered hopper	American Car & Fdry.

FREIGHT-CAR INQUIRIES

Reading	1,000	50-ton box	

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Chicago, Burlington & Quincy	2[2]	Comb. bagg. & buffet	Edw. G. Budd
	8[2]	Chair	Edw. G. Budd
	2[2]	Diners	Edw. G. Budd
	2[2]	Parlor-lounge	Edw. G. Budd
	1[3]	Bagg.-mail	Pullman-Std.
	4[3]	Chair	Pullman-Std.
	1[3]	Grill	Pullman-Std.
	1[3]	Diner	Pullman-Std.
	4[3]	Sleeping	Pullman-Std.
	1[3]	Obs.-lounge	Pullman-Std.
	5[4]	Bagg.-mail	Edw. G. Budd

[1] Ten will be experimental, lightweight cars.

[2] For two complete new sets of equipment for the Chicago-Twin City Zephyrs. Each of the chair cars and the parlor-lounge cars will contain "Vista Domes"—raised glass-enclosed observation rooms—developed by General Motors Corporation, and introduced in an experimental Burlington car on July 23. The cars will be of stainless-steel construction.

[3] For a 12-car "Empire Builder," the Burlington's share of the five trains required to streamline the Chicago-Pacific Northwest service operated in connection with the Great Northern.

[4] To complete the streamlining of the Burlington's daytime Zephyr service between Chicago and Omaha, Neb., and Lincoln. The cars will be stainless steel.

NOTES:

Plans have been virtually completed for new streamline passenger-train service between Chicago and Florida points, by the Pennsylvania, Chicago & Eastern Illinois, and Illinois Central and their southern connections. The proposed new trains will be powered by 4,000-hp. Diesel-electric locomotives and will consist of coaches, diner and all-room sleeping cars. It is expected that the trains will comprise 14 cars each and will cost about $1,500,000 each, ownership will be shared by the Louisville & Nashville; Nashville, Chattanooga & St. Louis; Atlantic Coast Line; Florida East Coast; and Central of Georgia.

The Chicago, Burlington & Quincy, in association with the Denver & Rio Grande Western and the Western Pacific, is planning the purchase of 60 passenger cars of stainless-steel construction to re-equip the "Exposition Flyer" now operated daily by these lines between Chicago and San Francisco.

(Turn to second left-hand page)

To do Today's Job

• Union Pacific's mighty 4-8-8-4's, designed to meet today's tremendous demands for fast freight movement, are capable of continuous operation under maximum horsepower output.

The firebox of each locomotive of this type is equipped with seven Security Circulators, making it possible to maintain a well proportioned brick arch.

The Water Line is Your Life Line

AMERICAN ARCH COMPANY, INC.
NEW YORK · CHICAGO
SECURITY CIRCULATOR DIVISION

IT'S A GREAT NEW DAY FOR RAILROADING

It makes little difference to a General Motors Diesel freight locomotive!

GENERAL MOTORS
LOCOMOTIVES

IT'S A GREAT NEW DAY FOR RAILROADING

Denver & Rio Grande
Western's 540
over mountainous terrain
rolled up
337,728 miles between
January 1942 and January 1945.
Average availability 83.7%.
Average miles per month 9,650.

St. Louis & Southwestern's 900
over flat country rolled up
66,998 miles between
June 1944 and January 1945.
Average availability 89.3%.
Average miles per month 11,166.

It makes little difference—
over mountains or on the level.

ON TO FINAL VICTORY ★ BUY MORE WAR BONDS

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION · LA GRANGE, ILL.

Supply Trade Notes

WORTHINGTON PUMP & MACHINERY CORPORATION.—*Ralph M. Watson,* formerly chief engineer of the centrifugal engineering division of the Worthington Pump & Machinery Corporation, has been appointed assistant to Harry A. Feldbush, vice-president in charge of engineering.

◆

WESTINGHOUSE ELECTRIC CORPORATION.—*Edgar W. Bartz* has been appointed welding specialist for the San Francisco, Cal., bay area for the Westinghouse Electric Corporation. Prior to his recent transfer to San Francisco, Mr. Bartz had served in the company's Trafford, Pa., plant as a specialist in electric welding electrodes and materials.

The Westinghouse Electric Corporation has acquired the B. F. Sturtevant Company of Boston, Mass., manufacturer of air handling and processing equipment, which it will operate as a division of the parent company. In addition to its main plant at Boston, the Sturtevant Company has factories at Camden, N. J., La Salle, Ill., Berkeley, Calif., and Galt, Ontario, Canada.

Frank C. Kline, special representative for the lamp division of the Westinghouse Electric Corporation in its Northwestern district headquarters at Chicago, has been appointed acting manager of the Southwestern district with headquarters at St. Louis, Mo., to succeed *Dan M. Galvin,* who is entering private business in Dallas, Texas.

◆

MONROE AUTO EQUIPMENT COMPANY.—The Monroe Auto Equipment Company, Monroe, Mich., has purchased a large new plant at Hillsdale, Mich., which will be equipped to compound and mould rubber and synthetics. The new plant is a part of a $1,500,000 expansion program recently announced by the company.

Donald L. Whitehouse, assistant manager of the Washington, D. C., office of the Monroe Auto Equipment Company, has been appointed manager of the newly established office in Chicago. The new office, which is located at 3001 Willoughby Tower building, Chicago, will handle sales of all of the company's products in the West.

◆

ECONOMY ARCH COMPANY.—*Henry K. Patjens* has been elected president of the Economy Arch Company of St. Louis, Mo. For the past seven years Mr. Patjens has been a sales engineer of the Baldwin Locomotive Works with headquarters in St. Louis.

◆

AMERICAN STEEL & WIRE COMPANY.—*Harry M. Francis* has returned to the American Steel & Wire Co., U. S. Steel subsidiary, where he will resume his duties as assistant vice-president, sales, following a three-year period of service with the War Production Board in Washington.

REPUBLIC STEEL CORPORATION—*N. J. Clarke,* vice-president in charge of sales, has been elected senior vice-president of the Republic Steel Corporation and *J. M. Schlendorf,* assistant vice-president of sales has been elected vice-president in charge of sales to succeed Mr. Clarke.

N. J. Clarke

N. J. Clarke began his career as an office boy with the Bourne-Fuller Company in 1897. He was appointed salesman and later manager of the company's Pittsburgh, Pa., office and was transferred to Cleveland in 1912 as secretary and sales manager of the Upson Nut Company which Bourne-Fuller had acquired. He was a major in the ordnance department in the first world war, after which he returned to Bourne-Fuller as vice-president and general manager. He organized and became president of the Lake Erie Bolt & Nut Co. in 1919. Mr. Clarke was appointed vice-president in charge of sales for Republic in September, 1930, shortly after the corporation was formed.

J. M. Schlendorf was employed with the American Sheet & Tin Plate Co. from 1905 to 1915. During the next two years he was assistant purchasing agent of the Willys-Overland Company and in 1917 was appointed vice-president in charge of sales of the Central Steel Company, Massillon, Ohio. He continued in that position when Central Steel and the United Alloy Steel Corporation merged in 1926 to form the Central Alloy Steel Corporation. When that company became a part of the Republic Steel Corporation in 1930, Mr. Schlendorf was appointed manager of sales of the alloy steel division. He was appointed assistant vice-president in charge of sales in 1936.

J. M. Schlendorf

◆

LAMSON & SESSIONS COMPANY.—The Lamson & Sessions Company, Cleveland, Ohio, has acquired the Key Bolt Appliance Division of Hardinge Brothers, Inc., of Elmira, N. Y.

◆

MALABAR MACHINE COMPANY.—*Ralph W. Payne* of Washington, D. C., and *E. A. Thonwell* of Atlanta, Ga., have been appointed to the sales force of the Malabar Machine Company, product division of the Menasco Manufacturing Company.

◆

UNITED STATES STEEL CORPORATION.—*Charles H. Rhodes,* vice-president of the United States Steel Corporation at Chicago, has retired.

◆

FINCH TELECOMMUNICATIONS, INC.—*Captain W. G. H. Finch,* United States Naval Reserve, has been returned to inactive duty and will assume the presidency of Finch Telecommunications, Inc., Passaic and Clifton, N. J.

◆

JOSEPH T. RYERSON & SON, INC.—*Roland W. Burt,* eastern manager of railroad sales, has been appointed manager of the Tubular Products division of Joseph T. Ryerson & Son, Inc., with headquarters in Chicago.

◆

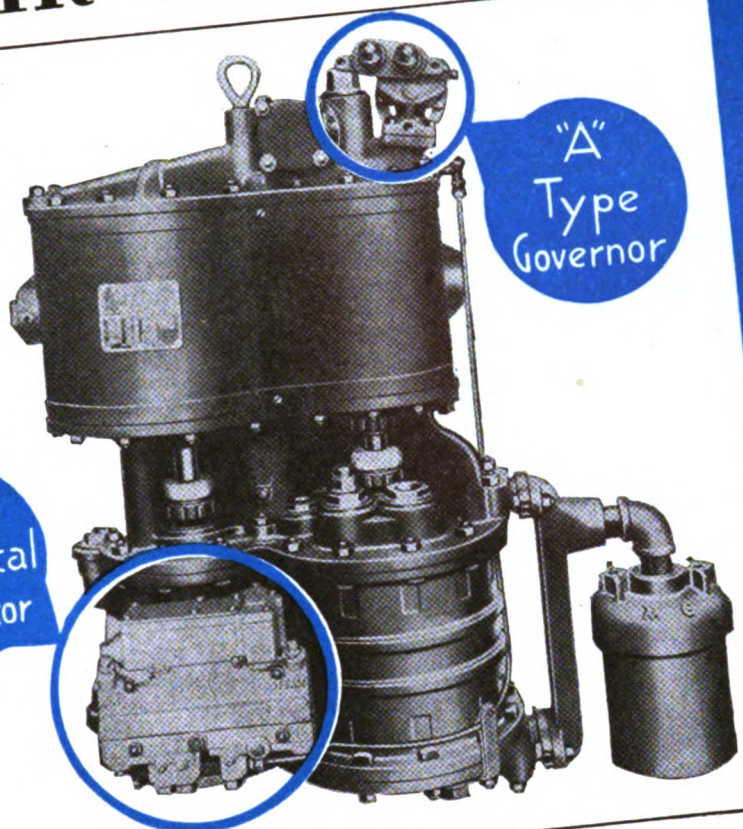
PHILIP CAREY MANUFACTURING CO.—*C. L. Owens,* assistant general sales manager, has been appointed general sales manager of the Philip Carey Manufacturing Co., Cincinnati, Ohio.

◆

AMERICAN ROLLING MILL COMPANY.—The functions of the Armco Railroad Sales Company, a wholly owned subsidiary of the American Rolling Mill Company, have been discontinued. The company's sheet and wheel business has been transferred to the American Rolling Mill Company and its drainage and fabricated products in the railroad field will be handled by the Armco Drainage & Metal Products, Inc., another wholly owned subsidiary. All of the Armco Railroad Company's key men and clerical force will become part of the American Rolling Mill organization. The following changes have been made: *Logan T. Johnson,* president and general manager, has been appointed administrative assistant to the sales manager of the American Rolling Mill Company; *H. M. Arrick,* district manager in St. Louis, Mo., has been appointed district manager of Armco in St. Louis; *Robert Y. Barham,* district manager in Chicago, has been appointed assistant district manager of Armco in Chicago; *G. Russell Betts,* salesman in the Chicago office, has been appointed manager

(*Continued on next left-hand page*)

8½" AIR COMPRESSOR



with Integral Lubricator and Governor

Integral mounting of the Lubricator and Governor simplifies installation and maintenance by eliminating the piping and fittings associated with independent mounting.

F-2 Lubricator has three feeds; two feeds for the air cylinders are cored through the mounting pads; the third feed supplies the entire steam end through a single tube.

Westinghouse Air Brake Company

Wilmerding, Pa.

of railroad sales, O'Neall division, Armco Drainage & Metal Products, Inc., Chicago; *Charles M. Colvin,* sales engineer, Berkeley, Calif., has been appointed sales engineer, Armco Drainage & Metal Products, Berkeley; *W. N. Crout,* district manager in Cleveland, has been appointed assistant district manager for Armco in Cleveland; *W. P. Lipscomb,* district manager, Richmond, Va., has been appointed Armco's representative in Richmond; *N. A. Powell,* district manager, Houston, Tex., has been appointed manager of railroad sales, southwestern division, Armco Drainage & Metal Products, Houston; *W. O. Robertson,* district manager, Philadelphia, Pa., has been appointed manager of railroad sales, eastern division, Armco Drainage & Metal Products, Philadelphia; *K. A. Smith,* district manager, Berkeley, Calif., has been appointed district manager, Armco Drainage & Metal Products, Berkeley, and *James L. Turvey,* salesman, New York, has been appointed a salesman for Armco in New York.

◆

EDWARD G. BUDD MANUFACTURING COMPANY.—A two-year reconversion and expansion program costing $16,000,000 is under way at the Edward G. Budd Manufacturing Company's plants in Philadelphia, Pa., and in Detroit, Mich., according to Edward G. Budd, president. Of this total, $1,750,000 will be spent for reconverting and equipping Budd's Red Lion plant, recently leased for the manufacturing of from two to four stainless steel railroad passenger cars per day. This work is expected to be completed early next year. Construction of railroad cars has already been started without waiting for completion of this program and the first cars are expected to come off the lines this fall.

◆

GENERAL ELECTRIC COMPANY.—*Harry A. Winne,* vice-president in charge of engineering for the General Electric Company's apparatus department, has been appointed vice-president in charge of engineering policy for the entire company, with headquarters in Schenectady, N. Y. *Ernest E. Johnson,* assistant engineer of the aeronautics and marine engineering division, has been appointed to succeed Mr. Winne in the apparatus department. *Victor S. Harrington* has been appointed district manager of the newly created transportation division of the company's Pacific district apparatus department, with headquarters in San Francisco, Calif. For the past several years Mr. Harrington has been transportation specialist in the San Francsico office. *Henry I. Guy,* assistant manager of the transportation divisions at the Erie, Pa., works, has retired after more than 40 years of service with the company.

Harry A. Winne joined General Electric as a student engineer in the testing department after his graduation from Syracuse University with a degree in electrical engineering in 1910. The following year he was appointed head of the large motor, generator, and synchronous converter test, and subsequently assistant general night foreman of the testing department. In 1916 he was promoted to the power and mining engineering department, now known as the industrial divisions, and six years later was assigned to the steel mill section of the industrial engineering department, becoming head of that section in 1930. He was appointed sales manager of the combined mining and steel mill section and, in April 1937, assistant to the engineering vice president. He was elected vice-president in charge of apparatus design engineering in October, 1941, and of the engineering apparatus department in January, 1945.

Ernest E. Johnson joined the General Electric testing department after his graduation from Washington State College in 1922 with a degree in electrical engineering. He was assigned to the engineering general department in 1924; appointed assistant to the executive engineer of the General Electric research laboratory in 1931; engineer of the generator voltage regulator department in 1934, and assistant to the assistant to the Schenectady works manager in 1938. He subsequently became engineer of the aeronautics division, aeronautics and marine engineering department and for the past few years has been assistant engineer of the aeronautics and marine engineering division.

◆

ELASTIC STOP NUT CORPORATION OF AMERICA.—*O. M. Hullinger* has been appointed manager of the Chicago office of the Elastic Stop Nut Corporation of America, with headquarters at 20 North Wacker Drive.

Mr. Hullinger came to the Esna corporation from the Line Material Company, where he was manager of transformer sales. Previous to that, he had served as sales manager for the Tips Tool Company. He was also with the Ohio Brass Company, and worked in railroad and public utility fields for many years. He received his engineering training at Armour Institute of Technology.

◆

RANSOME MACHINERY COMPANY.—*Hobart C. Ramsey,* executive vice-president of the Worthington Pump & Machinery Corp., has been appointed also president of the Ransome Machinery Company, a Worthington subsidiary. *J. G. Ten Eyck,* who has just completed five years of active service with the U. S. Navy and who formerly was president of the industrial engineering firm of Ten Eyck, Inc., has been appointed vice-president and general manager of Ransome and *Kenneth W. Horsman,* formerly superintendent of welding and steel fabrication at Worthington's Harrison, N. J., works, has been transferred to Ransome as works manager.

◆

ARCO COMPANY.—Plans have been announced for the immediate construction of a two-story research laboratory for the development of improved paints, lacquers, varnishes and new industrial coatings. The structure will be of steel and brick construction and will be located adjacent to the Arco Company's general offices at 7301 Bessemer Avenue, Cleveland.

◆

NATIONAL BATTERY COMPANY.—The National Battery Company has announced plans for a new building on approximately eight acres of land in St. Paul, Minn., which it recently purchased from the Northern Pacific.

ADAMS & WESTLAKE CO.—*Russell D. John* has been appointed general sales manager of the Adams & Westlake Co. with headquarters in Elkhart, Ind. Mr. John joined the company as a salesman in the southeastern territory in 1926. He was appointed eastern manager in charge of the company's New York office in 1936. *Fred C. Rauch* succeeds Mr. John as eastern manager.

◆

R. D. WOOD COMPANY.—The R. D. Wood Company has moved its Philadelphia, Pa., offices to the Public Ledger Building, Independence Square.

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—The Pullman-Standard Car Manufacturing Company, on September 1, announced that it has purchased from the Navy Department the huge ship assembly building erected at its car works plant in Chicago for the construction of ships. The sale places at the disposal of the company a building which will form the nucleus for a new passenger-car body shop. The structure, which has an area of 171,000 sq. ft., will be expanded to more than twice its present size and, in addition, will be provided with a covered section of another 40,000 sq. ft. for steel storage. When completed, the new shop will replace the present steel shop.

Obituary

FRED A. PAWSEY, chief engineer of the Ohio Locomotive Crane Company, Bucyrus, Ohio, died September 3. Mr. Pawsey was graduated from the Case School of Applied Science in 1905 and has been associated with the Ohio Locomotive Company since July, 1919.

◆

CHARLES H. WILSON, manager of the Fairbanks, Morse & Company, railroad sales division, died in Chicago on September 13 following a brief illness.

◆

R. G. PHILLABAUM, service engineer of the Locomotive Finished Material Company, in Chicago, was killed in an accident at his home on September 1.

◆

F. ARCHER THOMPSON, head of the Detroit, Mich., office of the Bullard Company's machine-tool plant at Bridgeport, Conn., died July 31. He was 62 years of age.

◆

MORRIS S. EARL, Chicago district manager of the Electric Service Manufacturing Company, died suddenly on September 3. Mr. Earl had been with the Electric Service Manufacturing Company since its formation in 1906. He was 62 years old.

◆

EDWARD STEPTOE EVANS, founder and president of the Evans Products Company, Detroit, Mich., died on September 6. Mr. Evans was born at Thaxtons, Va., on May 24, 1879, and was educated at George Washington University. In 1915 he founded the Evans Products Company which has been active in the development of autoloading devices for freight cars and other

(Continued on next left-hand page)

The Atlantic Coast Line adopts "UNION" I.T.C.

to expedite road and yard traffic

In a move to expedite both freight and passenger traffic on its lines between Rocky Mount, N.C. and Wilmington, N.C., and between Wilmington, N.C. and Florence, S.C., the Atlantic Coast Line Railroad has begun the installation of "Union" Inductive Train Communication in this area.

Equipment of the frequency-modulation type for four wayside stations and 36 vehicles has been ordered, which will equip all regularly scheduled freight and passenger trains operating on specified lines of road.

"Union" I.T.C. will also be installed in the freight yards at South Rocky Mount and equipment for two yardmaster offices and nine switching locomotives has also been ordered.

The line to be equipped includes that portion of the double-track line from Rocky Mount to Contentnea, N.C.; the single-track line from Contentnea to Pee Dee, S.C., by way of Wilmington, and that portion of the double-track line from Pee Dee to Florence.

In addition to the immediate advantages derived from this system of train communication, the Atlantic Coast Line expects to gain experience in methods of utilizing these advantages in main-line operation.

"Union" Inductive Train Communication was selected for this service because it is to a unique degree a railroad man's system. Communication is not broadcast, but is directed along the tracks and adjacent line wires; and the system is as easy to use as the telephone.

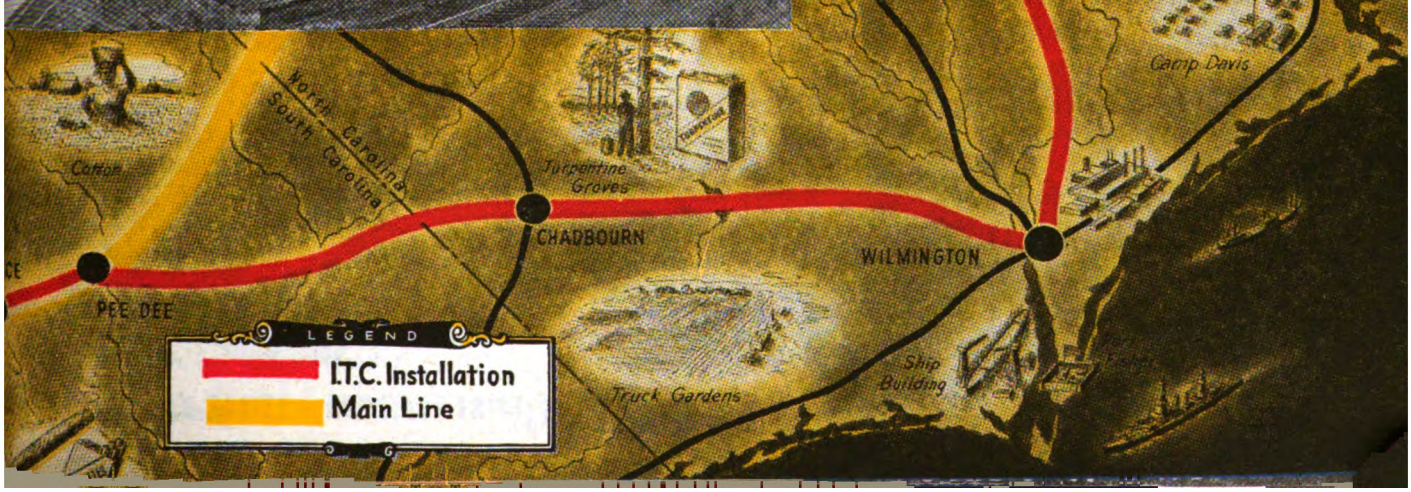
Eighteen "Union" I.T.C. installations are now in service on 8 railroads. One yard and two road installations are under construction.

UNION SWITCH & SIGNAL CO.

SWISSVALE **PENNSYLVANIA**

NEW YORK
CHICAGO

ST. LOUIS
SAN FRANCISCO



railroad equipment. During World War I, he served as a captain in the Quartermaster Corps, United States Army, and at the time of his death held a commission as Lieutenant Colonel, specialist reserve, U. S. Air Corps.

◆

EDWARD J. SEARLES, manager of the Schaefer Equipment Company, Pittsburgh, Pa., died August 13. Mr. Searles was 69 years of age. He attended Johns Hopkins University. Following the completion of his engineering studies, he entered the apprentice training school of the Pennsylvania at Altoona, Pa., and subsequently progressed through many positions in the mechanical department of that railroad. Later he was employed by the Baltimore & Ohio and served in various capacities in the motive power department and ultimately as superintendent of motive power at Pittsburgh, Pa. He next was associated with the American Brake Shoe Company. He joined the Schaefer Equipment Company in 1914. Mr. Searles had been for many years treasurer of the Railway Club of Pittsburgh.

Edward J. Searles

◆

EDWARD L. GOODWIN, senior assistant mechanical superintendent of the Pullman Company, died on September 6, at his home in Chicago, after a long illness. Mr. Goodwin was 60 years of age and had served the Pullman Company for nearly 40 years.

◆

CHARLES W. BURNS, who retired in October, 1937, as assistant to the mechanical superintendent of the Pullman Company, died at his home in Muskegon, Mich., on August 9.

Personal Mention

General

A. K. GALLOWAY, general superintendent motive power and equipment of the Baltimore & Ohio at Baltimore, Md., has had his jurisdiction extended to cover the Baltimore & Ohio Chicago Terminal.

J. S. BREYER, master mechanic of the Southern at Meridian, Miss., has been appointed to the newly created position of general industrial agent, with headquarters at Meridian.

W. R. HEDEMANN, engineer of tests of the Baltimore & Ohio at Baltimore, Md., has had his jurisdiction extended to cover the Baltimore & Ohio Chicago Terminal.

W. G. MCPHERSON, assistant superintendent of motive power, eastern lines, of the Canadian Pacific at Toronto, Ont., has retired.

O. R. BAREFOOT, division master mechanic of the Canadian Pacific at Toronto, Ont., has been appointed assistant superintendent of motive power, eastern lines, with headquarters at Toronto, Ont.

H. L. OUSLEY, air brake inspector of the Southern at Charlotte, N. C., has been appointed general Diesel supervisor at Spencer, N. C.

HARRY REES, superintendent motive power, Central Region, of the Baltimore & Ohio at Pittsburgh, Pa., has had his jurisdiction extended to include the Baltimore & Ohio Chicago Terminal.

J. T. MALLARD, master mechanic of the Norfolk Southern's Raleigh shops at Raleigh, N. C., has retired, and that position has been abolished.

W. B. WHITSITT, chief engineer motive power and equipment of the Baltimore & Ohio at Baltimore, Md., has had his jurisdiction extended to cover the Baltimore & Ohio Chicago Terminal.

J. H. WHIPPLE, JR., supervisor of Diesel equipment of the Denver & Rio Grande Western at Burnham, Denver, Colo., has been appointed to the newly created position of superintendent of Diesel equipment for the system, with headquarters at Burnham.

FRED BUSCHER, foreman machine shop of the Northwestern Pacific at Tiburon, Calif., has been promoted to the position of foreman motive power and car departments, general shops, at Tiburon, Calif.

Master Mechanics and Road Foremen

K. A. LENTZ, master mechanic of the Southern, at Somerset, Ky., has been transferred to Meridian, Miss.

JOHN FRANCIS LEIGHTIZER, master mechanic of the Prince Edward Island Division of the Canadian National, has retired after more than 40 years of service.

S. H. DUBOSE, master mechanic of the Southern at Ludlow, Ky., has been transferred to the position of master mechanic at Somerset, Ky.

D. J. EVERETT, general mechanical inspector of the Atchison, Topeka & Santa Fe at Topeka, Kan., has been appointed master mechanic of the Gulf, Colorado & Santa Fe, with headquarters at Galveston, Tex.

A. T. LOHMANN, master mechanic of the Northern division of the Gulf, Colorado & Santa Fe at Cleburne, Tex., has retired.

J. J. FRIEBOLT has been appointed road foreman of engines, Arkansas division, of the Missouri Pacific, with headquarters at Little Rock, Ark.

J. D. NIMMO, master mechanic of the Gulf Division of the Gulf, Colorado & Santa Fe, at Galveston, Tex., has been transferred to the Northern division, with headquarters at Cleburne, Tex.

HAROLD EDWARD MOORE has been appointed master mechanic of the Prince Edward Island division of the Canadian National.

W. N. FOSTER, road foreman of engines on the East End of the Cumberland division of the Baltimore & Ohio, retired on June 1 after 45 years' service.

R. G. FIELD, assistant master mechanic of the Southern at Meridian, Miss., has been appointed master mechanic at Ludlow, Ky.

Car Department

EARL EAGLETON, coach foreman at the Decatur, Ill., shops of the Wabash, has been appointed car shop superintendent at Decatur.

A. L. GANTT has been appointed air brake instructor of the Southern, with headquarters at Spencer, N. C.

Shop and Enginehouse

GEORGE W. SOMERS, foreman boilermaker of the Canadian National at Halifax, N. S., has been appointed boiler inspector, Atlantic region, with headquarters at Moncton, N. B.

W. S. DOUGLAS, boiler foreman of the Canadian National at Fort Rouge, Man., has been appointed chief boiler inspector, western region.

L. E. BERRY, general foreman of the Norfolk & Western at Portsmouth, Ohio, has been transferred to the position of general foreman at Crewe, Va.

W. M. TUCKER, a foreman of the Norfolk & Western at Iaeger, W. Va., has been promoted to the position of night enginehouse foreman at Shenandoah, Va.

G. W. HOOPER, assistant foreman of the machine shop of the Norfolk & Western at Roanoke, Va., has retired.

(Turn to next left-hand page)

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CHICAGO

HARRISON H. WOSSER, lead machinist of the Northwestern P acific at Tiburon, Calif., has been promoted to the position of foreman machine shop.

E. E. BARTON, a machinist in the Roanoke, Va., shops of the Norfolk & Western, has been promoted to the position of assistant foreman of the machine shop.

H. B. ROBINSON, night enginehouse foreman of the Norfolk & Western at Shenandoah, Va., has been promoted to the position of general foreman at Portsmouth, Ohio.

R. L. BLACK, superintendent of the Roanoke, Va., shops of the Norfolk & Western, has retired.

W. E. BOWES, enginehouse foreman of the Pennsylvania, Pittsburgh division, with headquarters at Conemaugh, Pa., has been appointed enginehouse foreman — special duty, master mechanic's office, Pittsburgh division.

G. T. SAVAGE, enginehouse foreman at the Kinsman street enginehouse of the Pennsylvania at Cleveland, Ohio, has been appointed enginehouse foreman, Pittsburgh division, with headquarters at Conemaugh, Pa.

BERNARD COOK, general foreman, locomotive department, of the Norfolk & Western at Roanoke, Va., has been appointed superintendent of the Roanoke shops.

W. S. GARRETT, general foreman of the Norfolk & Western at Crewe, Va., has been promoted to the position of general foreman, locomotive department, at Roanoke, Va.

F. E. GODWIN, district boiler inspector of the Canadian National, Montreal, Que., district, has been appointed mechanical inspector of locomotives at Montreal.

J. E. WEISER, foreman of the Norfolk & Western at Winston-Salem, N. C., has been promoted to the position of foreman at Iaeger, W. Va.

E. H. ROY has been appointed general foreman of the Raleigh shops of the Norfolk Southern with headquarters at Raleigh, N. C.

W. H. STEVENSON, for the last four years assistant superintendent of munitions at the Ogden shops of the Canadian Pacific in Calgary, Alta., has been appointed works manager of the shops.

W. J. TOSTEVIN, assistant foreman at the Toronto, Ont., enginehouse of the Canadian National, has been appointed boiler inspector of the Montreal, Que., district.

Obituary

FRANK W. THOMAS, retired supervisor of apprentices of the Atchison, Topeka & Santa Fe, died in Topeka, Kan., on September 13.

ROBERT SALKELD, foreman motive power and car departments, general shops, of the Northwestern Pacific at Tiburon, Calif., died on August 14.

G. C. ELLER, assistant road foreman of engines of the Pennsylvania, Panhandle division, died on June 26.

G. A. MARX, car shop superintendent of the Wabash, at Decatur, Ill., died suddenly at Decatur, on August 16.

In Military Service

LEGION OF MERIT AWARD.—Charlie M. McManaway, a first lieutenant in Iran, has been awarded the Legion of Merit for "exceptionally meritorious conduct in the performance of outstanding service," according to word from Headquarters, Persian Gulf Command. Lieutenant McManaway, once a shop inspector for the Norfolk & Western, won his citation for performance as superintendent of the blacksmith shop, in Teheran's locomotive shops. There, it is noted, "he demonstrated a high degree of organizing ability, technical proficiency, and attention to duty in training unskilled military personnel to be efficient blacksmiths, and in systematizing the various operations of the blacksmith shop to the point where the shop developed into an effective, well-organized unit." In addition, the citation continued, "Lt. McManaway, through outstanding skill and ingenuity developed special dies and jigs for the manufacture of other vitally-needed locomotive parts and at considerably lower cost."

M. R. S. ELECTRICAL TRANSMISSION COMPANY.—Electrical Transmission Company "D" of the 746th Railway Operating Battalion, the largest M. R. S. unit ever activated, recently has been on detached service with the 716th, and, according to the "Yankee Boomer" has "done some remarkable work in Germany." Assigned the job of operating the electrified line from Stuttgart to Augsburg, the 716th called in Captain Floyd D. Gibson, commanding officer of Company "D", four officers and 188 enlisted men who had trained on the Pennsylvania at Harrisburg, and on the New York Central at New York City. "D" company at once made surveys of the Stuttgart-Augsburg line, and repair work was begun on catenaries, sub-stations and transmission lines. German electrical maintenance men were also given jobs and were carefully supervised. "In less than six weeks," it is reported, electric locomotives were running on schedule from Munich to Stuttgart, with a Diesel shuttle system through Ulm. On this 130-mile stretch grades are reported "in excess of 2.5, but electric operation cut running time and hauled heavier loads," the report added.

763RD RAILWAY SHOP BATTALION.—The 763rd Railway Shop Battalion marked its second anniversary on July 28, at Louvain, Belgium, according to the Yankee Boomer. The battalion was organized in July, 1943, and since last December has repaired 109 2-8-0 locomotives, 20 0-6-0's and 13 Diesels, and processed 344 new locomotives of all types. At Louvain 6,508 locomotives have been dispatched, and at Antwerp, where Company "C" has been stationed, 7,470 cars have been repaired since February. The Antwerp unit has also aided the Belgians in the repair of 7,472 other cars.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

WASHING METHODS FOR RAILROADS.—Whiting Corporation, Harvey, Ill. Twelve-page, two-color bulletin, "Streamlined Washing Methods for Railroads," presents detailed drawings and photographs of the operation, construction and application of Whiting washers for motive power and rolling stock.

◆

WATSON-STILLMAN PRODUCTS.—Watson-Stillman Company, Roselle, N. J. *Bulletin No. 540-A.* Describes and illustrates Walter stock-adjusting machine for lengthening, straightening, and shortening locomotive parts. *Bulletin No. 550-A.* Describes, with specifications and illustrations, hydraulic spring shop equipment—stripping machine, banding and forming presses, and testing machines—for railroad shops.

◆

LIGHTING PRODUCTS.—Sylvania Electric Products Inc., 60 Boston street, Salem, Mass. Booklet containing comprehensive information about industrial, commercial, portable and inspection type fluorescent fixtures; fluorescent lamps, starters and lamp holders. Incandescent types listed include daylight lamps; large wattage lamps, vibration and rough service lamps; three-light lamps; floodlight and spotlight lamps; tubular lamps; lumline lamps; sign and decorative lamps; and those for 6, 12 and 32 volt service.

◆

FORGING TERMS.—Kropp Forge Company, 5301 W. Roosevelt Road, Chicago 50. Twenty-page illustrated booklet, "Glossary of Forging Terms," defines the terms as used in forging practice, it being recognized that other definitions are sometimes employed in other industries for describing identical processes or operations, abbreviations, or symbols of names of metals and alloying elements.

◆

PRECISION LATHES.—South Bend Lathe Works, 403 East Madison street, South Bend 22, Ind. Catalog 9-G describes and illustrates 9-in. South Bend precision lathes.

◆

HIGH-STRENGTH STEEL.—American Rolling Mill Company, Middletown, Ohio. Twenty-four page booklet, "Armco Low-Alloy High-Strength Steels" describes low-alloy steels with minimum yield strengths of 50,000 and 55,000 lb. per sq. in. Sections on drawing, forming and welding, also data on various designs.

◆

"CUTTING GEAR TEETH ON A MILLING MACHINE."—The Cincinnati Milling Machine Company, Cincinnati 9, Ohio. Publication No. M-1397. Contains brief instructions on cutting worms and worm-wheels, and spur, helical and bevel gear teeth on a milling machine. The text is general and applies to any make of milling machine.

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Railway Mechanical Engineer

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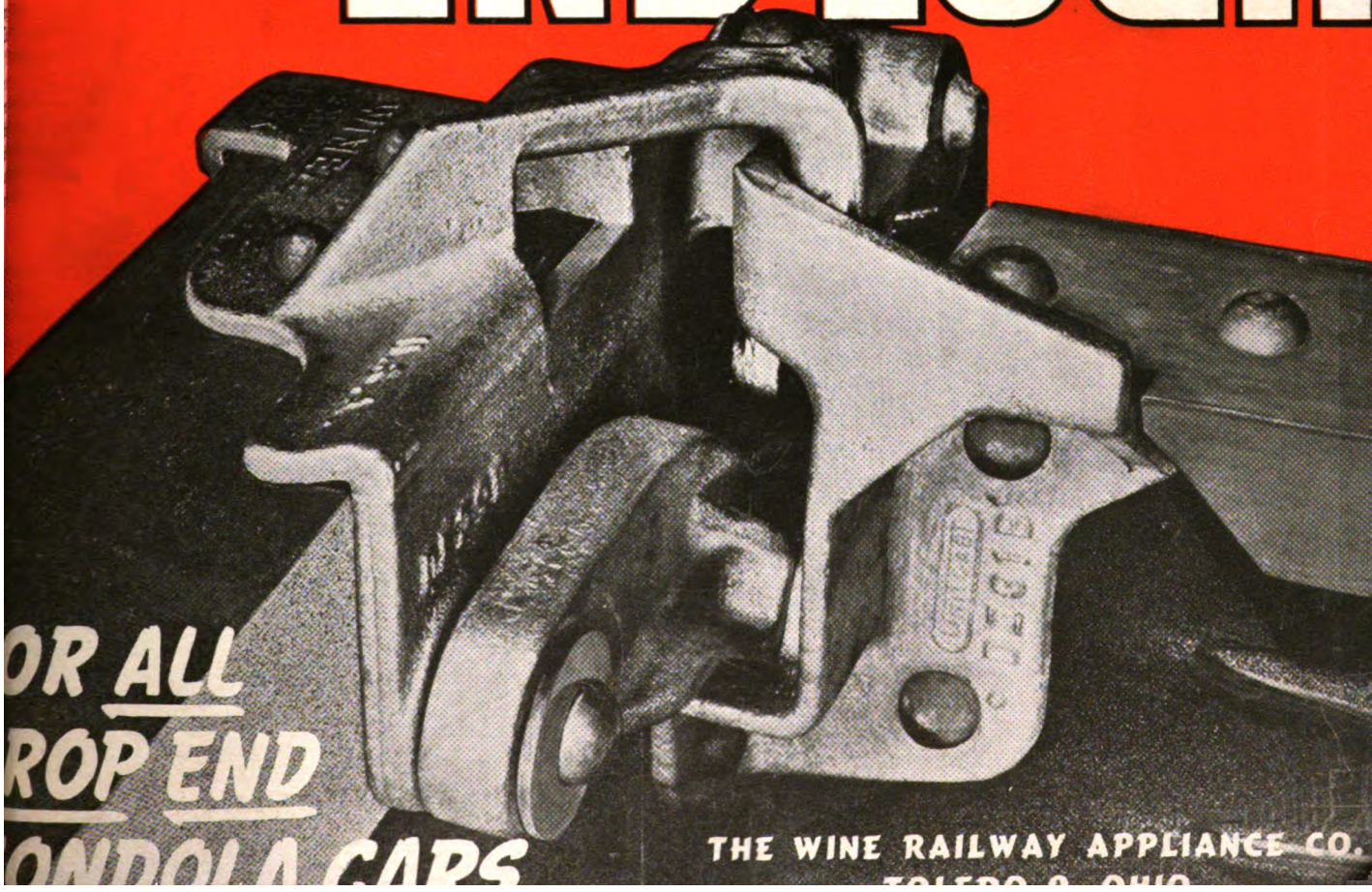

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Founded in 1832 as the American Rail-Road Journal

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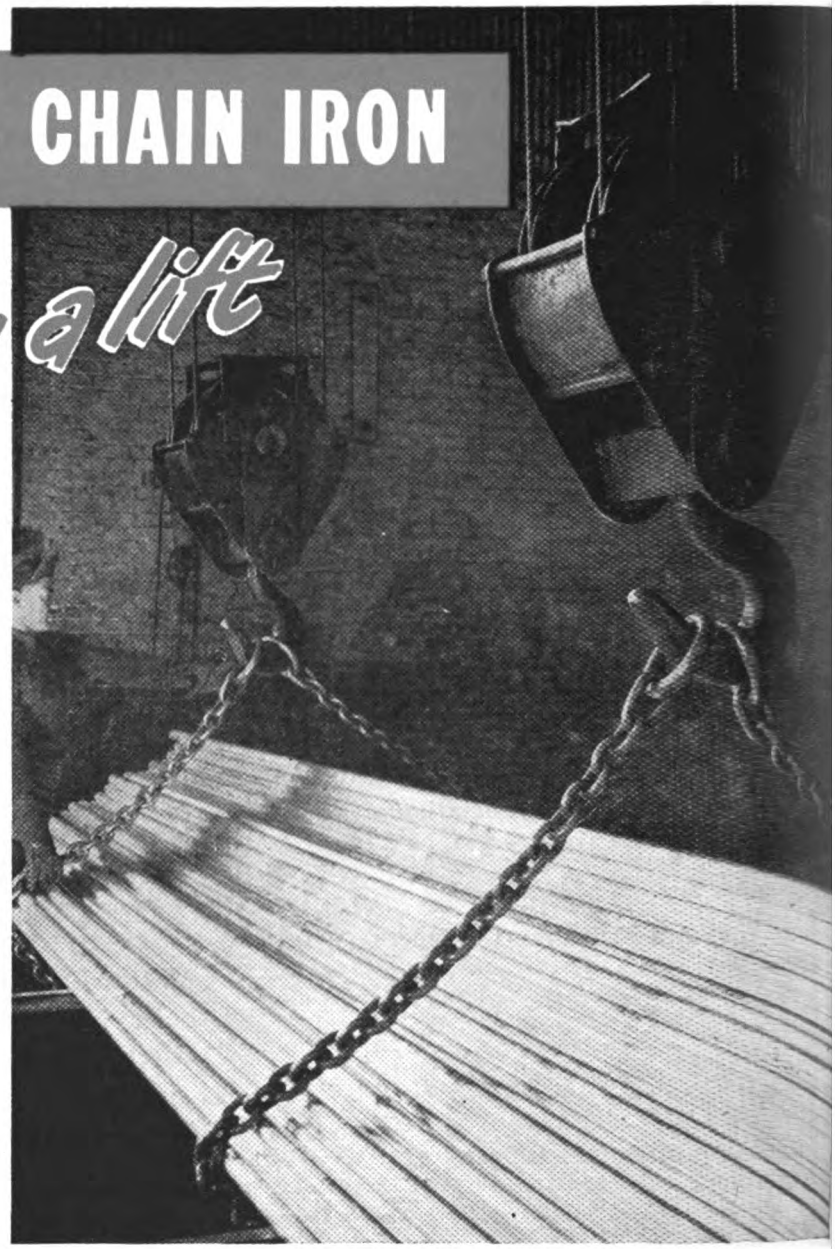

Here's some news that will be welcome to every man responsible for maintaining sling chains, and to every blacksmith who forges the links. Byers Chain Iron is now available for repair work, ready to add a new safety factor in material handling, and new ease and speed in chain recondition operations.

The biggest contribution that Byers Chain Iron makes is in the advance warning of failure it gives when overstressed. Links that have been loaded beyond their capacity "neck-out" so that the weakness is apparent in visual inspection, and the chain can be withdrawn for repair before failure actually occurs. The savings that this one unusual property has made in accidents avoided and equipment damage averted can hardly be overestimated.

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Conventions-in-Print

It has been the custom when the four Co-ordinated Mechanical Associations hold their annual conventions, to have one general session, including the entire group, at which an inspiring and instructive address is made by an outstanding personage in the railway world.

This Convention-in-Print, therefore, includes such a feature, but in the form of four relatively short, snappy messages from men who rank high in railway affairs in this most trying period in railway history— Col. J. Monroe Johnson, who has done such a fine and striking job as director of the Office of Defense Transportation; Russell G. Henley, quiet, but sound thinking and effective, who is chairman of the Mechanical Division, Association of American Railroads; and two comparatively young, but aggressive railroad chief executives who have demonstrated special ability in the field of leadership—Robert E. Woodruff, president of the Erie, in the East; and Fred G. Gurley, president of the Atchison, Topeka & Santa Fe, in the West.

Their messages sound keynotes for girding up for action by the four Co-ordinated Mechanical Associations and the resumption of their normal operations, including regular conventions in the fall of 1946. There is a large and important place in the railway field for these organizations. They fill a real need, and the words of encouragement and the practical messages from these leaders should do much to inspire them to still greater efforts in the days which lie before us, when the railroads will face bitter competition. A maximum of service, at minimum cost to the public, can only be achieved by the greatest possible efficiency in maintenance and operation of the equipment and facilities. These mechanical associations, conducted on a volunteer and free-will basis, have given a splendid account of themselves in the past, which, let us confidently hope, will be even bettered in the future.

The reports of the associations, which follow the introductory statements, speak for themselves, particularly in light of the fact that the committees have had to work under rather discouraging conditions and with little or no opportunity for conferences. The reports for the Master Boiler Makers' Association are incomplete and the missing ones will appear in later issues of the *Railway Mechanical Engineer* as they are received. On the whole, the record for the quality of the reports and the meeting of schedules for their completion, is exceptionally good, considering the circumstances. They presage well for the success of the program makers and the committees which will be charged with preparing the material for the conventions next year.

A Job Well Done—
But Not Finished

A MESSAGE FROM

COL. J. MONROE JOHNSON

DIRECTOR OF O. D. T.

For four years your organizations have voluntarily given up your annual gatherings in order to conserve wartime transportation, a most commendable and patriotic action. By means of the "Convention-in-Print" you have been able to have the benefit of official reports and valuable technical papers. Advertising in the Convention-in-Print issue of the *Railway Mechanical Engineer* has served as a substitute for the exhibits usually displayed at a convention headquarters.

But all this has by no means been a satisfactory substitute for the personal contacts and free interchange of opinion in a regular convention. I realize that this is particularly valuable in the case of the four Allied Railroad Mechanical Associations—The Master Boiler Makers' Association, Railway Fuel & Travelling Engineers Association, Car Department Officers Association, and the Locomotive Maintenance Officers Association. The association in these organizations is of very great benefit to their members, and, of course, to the railroads with which the individual members are connected.

Railway transport is going through a most critical transition period. The war is over, but there are millions of soldiers whose travel homeward presents a formidable passenger traffic problem. For the rest of the year our fighting men will be reaching our ports at the approximate rate of 900,000 a month. And the normal peak season for freight is now at hand.

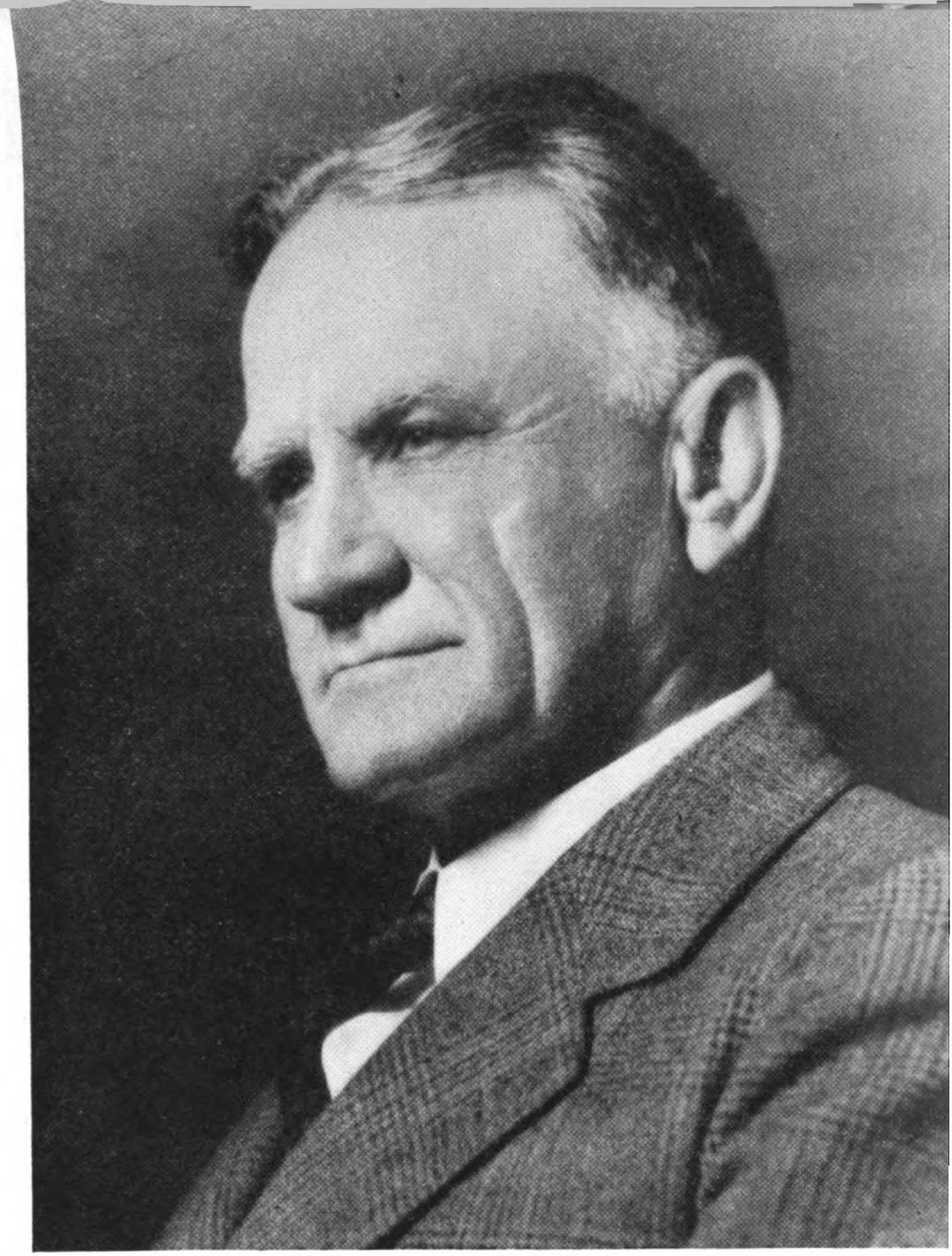
None know better than the members of your associations with what difficulty the railroads have managed to carry the enormous extra burdens of war traffic, while the war itself has made it impossible to secure more than a minimum of new equipment. The war has also reduced the ranks of railroad workers, with more than 300,000 men called into the armed services and their places to be filled by inexperienced men.

The members of your groups have played a leading part in keeping the railroads running during this emergency, with its unprecedented strain on all transportation facilities. You have had to use the utmost ingenuity in patching up equipment, in making repairs again and again where normal practice would call for scrapping old rolling stock and replacing it with new. You have had to learn new ways to make the most of low-grade fuels, and to shift from one type of coal to another. I do not consider myself competent to discuss all the individual technical problems you have encountered and conquered, but I understand the general situation well enough to realize that without you we could not have kept the railroads functioning during the war.

The railroads, having gone through four years of war must now solve a difficult post-war problem. It will be many months before the carriers will be able to replace the equipment worn out or made obsolescent during the war years. And yet during these months the railroads must be on their toes to secure their share of the country's transportation business. The competition of other forms of transportation will be greatly intensified because of wartime developments.

This means continued exercise of that ingenuity you of the Mechanical Associations displayed during the war. And many of you have learned new ways of doing things that will make for better railroading in days to come. You will be joined by railroad workers who have been acquiring valuable experience in the emergencies of war railroading in strange and far-off lands and under the most trying circumstances.

There can be no let-down as we move from wartime to peacetime operation of the railroads. It is not merely a matter of financial success for the railroad companies. There is a far more important objective. You must play your part in keeping the vast industrial and commercial machine of America running on high gear, in transporting the products of an expanding economy. You and I, all of us, must show the world that the American spirit that built the world's greatest military machine in a few months, can find in peacetime the inspiration for no less memorable achievements in the post-war remaking of the world.



COLONEL J. MONROE JOHNSON, director, Office of Defense Transportation, has made an enviable record for himself in the World War. Our nation was deeply shocked and greatly concerned when death removed Joseph B. Eastman from a key position in a time of crisis. Colonel Johnson, a civil engineer by training and a veteran of the First World War, in which he served as an officer of the 117th Engineer Regiment of the Rainbow Division, was drafted to succeed Mr. Eastman. Brilliant and fearless, he accepted the responsibility and has done a really magnificent job in helping to make the best possible use of our American transportation system for both war and civilian needs, and under almost impossible conditions. And he has fought hard—he is a South Carolinian and knows how to express himself—to secure support for the railroads, which have had to bear the brunt of the load.

RUSSELL G. HENLEY, chairman of the Mechanical Division, A.A.R., and general superintendent motive power of the Norfolk & Western, has demonstrated unusual ability as a leader of men and the builder of a strong and highly regarded mechanical department organization. This is not to be wondered at when we consider his thorough practical training, starting as a roundhouse mechanic, and his fine technical ability, which is flavored by a generous component of sound common sense. Keenly appreciative of its importance from a business and operating point of view, he has established unique records for the utilization of locomotives and rolling stock. Modest and soft spoken, he weighs his words carefully, and his suggestions as to where special effort should be made by the mechanical associations at this time are worthy of most careful and favorable consideration.

Suggestions for 1946 Programs

FROM

R. G. HENLEY

CHAIRMAN, MECHANICAL DIVISION, A. A. R.

For the fourth consecutive year the Co-ordinated Mechanical Associations will hold a "Convention-in-Print." The record volume of freight and passenger traffic handled by the American railroads during the war emergency, the prohibitions against conventions, and the necessity of supervisors remaining on the job have made this action necessary.

You are to be commended for your enthusiasm in carrying on the work of your associations in spite of extreme difficulties and severe handicaps. The papers in this "Convention-in-Print" will assist in keeping your Associations alive and will add much to the progress of railroad science.

Every effort should be made to avoid duplication of work and over-lapping of subjects. The importance of team work as against individual effort cannot be too greatly stressed. There should be some means for each of the four Co-ordinated Associations to keep closely in touch, and to seek the advice of the others in matters in which they are all interested. Progressive, or what some might term radical ideas, should be thoroughly discussed and after careful consideration routed through the Mechanical Division to such research groups that are properly equipped to further develop them.

At the present time it is my thought that the Co-ordinated Mechanical Associations should direct their efforts in the channel of better maintenance, and improvements in operation and servicing of both the existing as well as the modern equipment that will soon be in operation on the railroads. There is no better way you can be of assistance and aid to the railroads than to maintain the equipment at the highest standard, and in condition for the greatest availability, thereby rendering the very best service to our shippers and patrons.

That can be done best by all of the Associations working together intelligently and cooperatively. I hope this will be kept uppermost in the minds of all and the Co-ordinated Mechanical Associations will give thoughtful consideration to this in their preparation for and at their meetings in the Fall of 1946.

ROBERT E. WOODRUFF has worked his way from a section hand to the top of the Erie Railroad. He knows railroading from A to Z and has exercised rare judgment in taking advantage of technological improvements and applying sound business principles to railroad operation and administration. A keen student of men, with an engineering training as a background, he early recognized that the strength and effectiveness of an organization rests in the human element. Probably no other railway chief executive has given as much time and critical study to the selection, training, development and promotion of men—and it has borne rich fruit. He has been a consistent inspirer and supporter of groups of men who gather to study their common problems and train, by actual practice in their meetings, to develop and make their personalities more effective.

Supervisors Must Be Good Teachers

AN EXCELLENT SUGGESTION FROM

R. E. WOODRUFF

PRESIDENT, ERIE RAILROAD

"If you want a job well done, do it yourself."
"It's easier to do it myself than to show someone else."

EXPRESSIONS such as these were common in the railroad industry a few years ago. Many old timers thoroughly believed in them. We have all seen top management doing things that division officers should do: the Master Mechanic taking a job away from a Foreman and bossing it himself—a Foreman doing a bit of particular work, with four or five men standing around watching him—all of this because supervision had not been trained to teach.

In all my experience I have never known a single good natural teacher—without training. Some of us have thought we were good teachers, but we were not reliable, sometimes doing a good job and sometimes a poor one.

All of this has been changed by sound teaching methods, formulated along the lines of Job Instructor Training—the so-called "Sure-Fire Method" of teaching a little at a time, showing, telling, and repeating back. It is so simple that any man of ordinary intelligence can learn how to use this useful tool.

Many are not yet acquainted with it. It is one of the great things that have come out of war production. Now, instead of a Foreman doing a "ticklish" job, he can train his men to do it in the correct and safe way, and he himself can have the pride of knowing that he has accomplished something worth while.

We now have hundreds of men studying and applying Job Instructor Training, and I am convinced that any ordinary man can become a good teacher through learning the principles and correct practice under a competent instructor.

[Articles on how the Erie Railroad applied the Job Instructor Training methods appeared in the Railway Mechanical Engineer, August, 1943, page 349, and Railway Age, January 16, 1943, page 199.—EDITOR.]

Important Functions of Mechanical Associations

AN APPRAISAL BY

FRED G. GURLEY

PRESIDENT, ATCHISON, TOPEKA & SANTE FE

THE cost of maintaining cars and locomotives on Class I railroads in this country amounted to $962,241,672 during the first seven months of 1945, the highest of any similar period on record and an increase of 4.9 per cent over 1944, when the total reached $917,391,185. Undoubtedly, the efficient expenditure of such large sums is a primary responsibility of railway managements, and executive officers must exercise their wide experience and best judgment in establishing policies and general practices designed to make every dollar spent for equipment maintenance produce maximum results.

In the army, a general and his staff may know how to win a war, but unless they get that information down through individual company officers, sergeants and corporals to the men in the ranks, the war is lost! Similarly, in railway service, particularly equipment maintenance work, competent, well-informed master mechanics, shop superintendents, general foremen, department supervisors and gang leaders, both car and locomotive, are a vital necessity. Without them to instruct, supervise and, if you will, inspire the men who work under them, many man-hours will be lost, materials wasted and the best-laid plans of managements largely nullified.

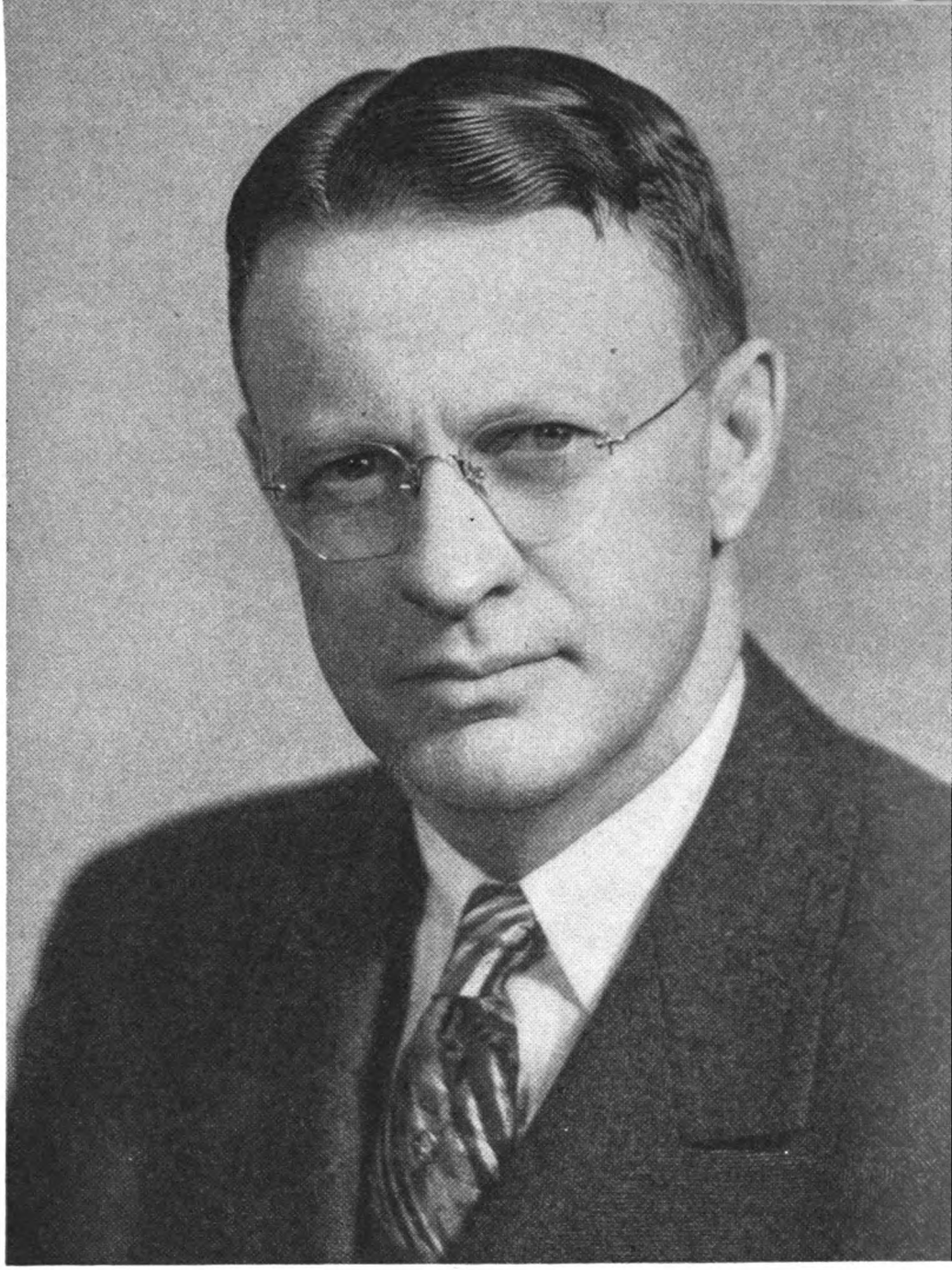
Ever since the turn of the century, a number of associations of railway mechanical department supervisors have played an important part in the self-improvement of individual members and hence increased the value of services rendered to their respective railroads. It is not too much to say that the Railway Fuel & Traveling Engineers' Association, an amalgamation of two groups, deserves a large share of the credit for railway accomplishments in fuel economy and improved engine service. The annual year books of this association constitute a library of useful information on these two associated subjects.

The Car Department Officers' Association, through its progenitors dating back to 1901, initially was formed to expedite the interchange of freight equipment and subsequently broadened its scope to include other major problems which confront car supervisors in connection with the construction, maintenance and use of all types of car equipment. Considering the vast expenditures of labor and materials annually for this purpose, any association such as the C. D. O. A. which promotes the interchange of ideas among car supervisors and tends to increase their knowledge and capacity is serving a constructive purpose.

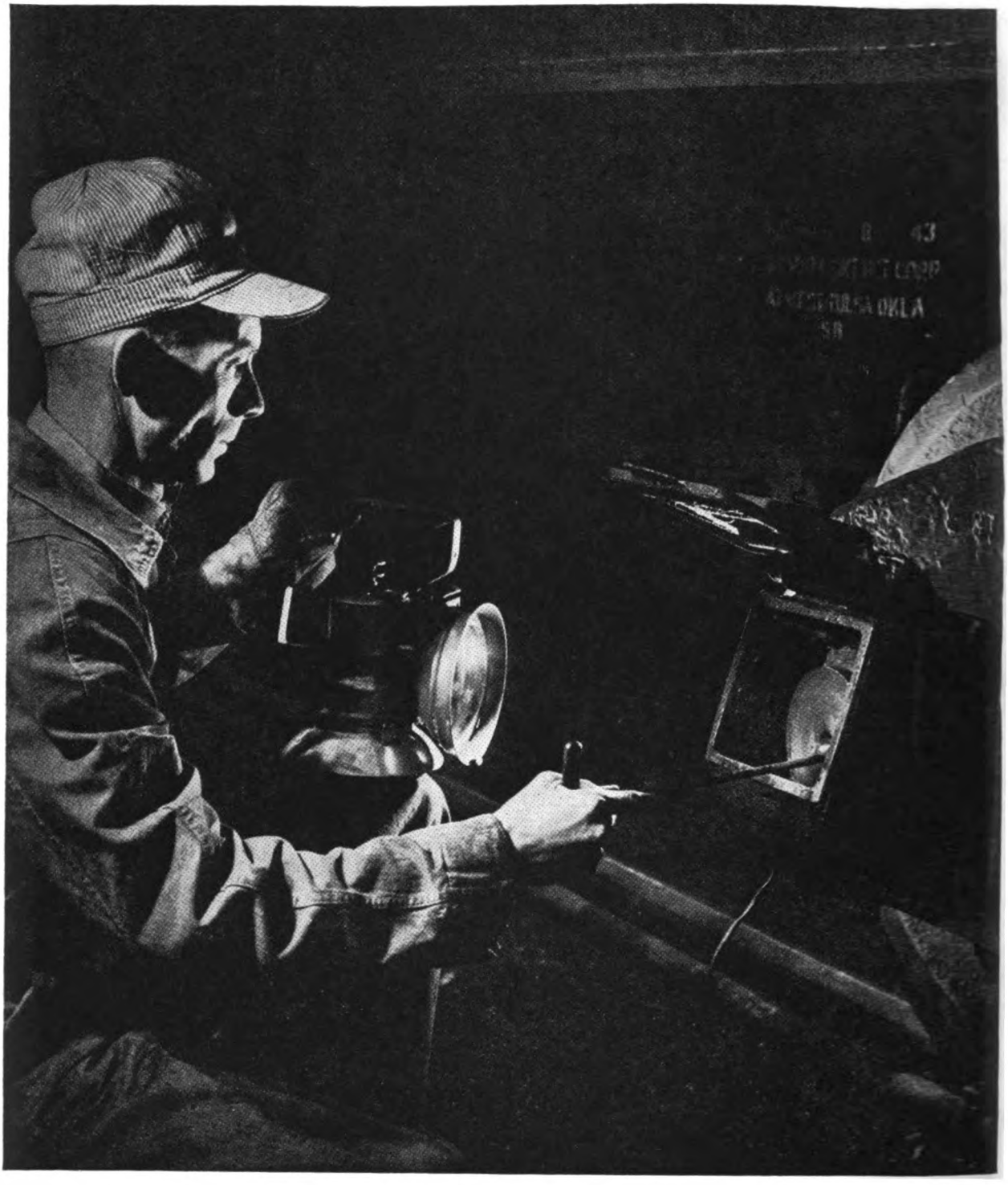
Similarly, the Locomotive Maintenance Officers' Association, which is an outgrowth of an earlier association of railway general foremen, offers as yet largely unexplored possibilities for the self training and improvement of supervisors in the large and highly important field of railway shops and enginehouses. One important subdivision of this field is being ably covered by the Master Boiler Makers' Association, a small but aggressive and forward-looking group whose annual proceedings present exceptionally valuable detailed information regarding the work of this craft.

The four groups mentioned were organized as the Coordinated Mechanical Associations prior to the war, with joint meeting dates and programs designed to avoid duplication or overlap and supplement the work of the A. A. R. Mechanical Division. Individual members comprise railway supervisors sufficiently interested in improved conditions to join the associations on a purely voluntary basis, give their time to committee work and, in many instances, attend meetings at their own expense.

Owing to the lapse of four years without annual meetings, due to war conditions, the affairs of all four of these associations are at a relatively low ebb and it is, therefore, gratifying to note tentative plans for a joint meeting next fall, possibly accompanied by an exhibit of improved railway materials and devices. Based on past accomplishments and future possibilities, the Coordinated Mechanical Associations deserve not only the general approval, but the active encouragement, support and help of railway managements.



FRED G. GURLEY, president of the Santa Fe, and one of our youngest railroad presidents, essentially quiet and modest in temperament, has a colorful and strong personality with a keen sense of humor. An exceptional organizer and administrator, he is cautious and conservative, as required by his responsible position, yet definitely forward-looking. His enthusiastic idealism is tempered by sound judgment and years of operating experience. Studious, ambitious and determined, he keeps one eye on the budget and the other on the operation of the railroad. A stickler for details and efficiency, he forms opinions slowly on the basis of a thorough study of the facts, and then sticks to his decisions, once agreed upon. He inspires co-operation and teamwork in his official family and is unstinting in praise of unusually good work by subordinates.



Car Department Officers' Association

Limited reports prepared in 1945—Stimulus of annual meeting needed to keep association functioning

LIKE other groups of mechanical department supersors, the Car Department Officers' Association has ntinued to function during 1945, but with activities d interest greatly curtailed due to necessary restricons, not only of annual meetings but executive and anding committee meetings. Generally speaking, it has en difficult for car men to devote any personal time committee work owing to the pressure of urgent duties keeping car equipment, both freight and passenger, in ndition to move during the war emergency. Many loyal fficers of the C.D.O.A. feel that without the stimulus f an annual meeting in 1946, and particularly the exressed approval and support of higher railway manageents, it will be almost impossible for the association to ntinue to function at all, let alone reach the constructive erformance level of which it is capable.

The affairs of the association have been conducted uring the last year under the leadership of acting presient and chairman of the executive committee the late . J. Krueger,* general superintendent car department, ew York, Chicago & St. Louis, Cleveland, Ohio.

Among other deterrents to progress of the C.D.O.A. as been the absence of so many of its members in mili ry service, and few have had a more interesting experince than President F. E. Cheshire, who received a comission in World War I and left his position as assistant uperintendent, car department, Missouri Pacific, to reenter the army in April, 1942, as a major of engineers. He was assigned shortly thereafter to transportation duty n London, returned to Washington as chief, Overseas Liaison, Office Chief of Transportation and, early in 943, was promoted to lieutenant-colonel, Transportaion Corps, in command of Camp Millard, Ohio, a techical training center for railway men. In March, 1944, e was activated and commanded the 709th Railway Grand Division which was sent overseas and served in France, Belgium and Luxemburg. He was promoted to olonel, Transportation Corps, returned to this country arly in 1945 and resumed civilian status last July as master mechanic for the Missouri Pacific at Osawatomie, Kan.

At a meeting of the C.D.O.A. Executive Committee on September 26, presided over by Chairman Krueger, Colonel Cheshire also resumed his duties as president of the association and will be assisted by present officers, who will continue to function until new ones are elected at the next annual meeting. Full committee reports of the C.D.O.A. will not be available for publication until issuance of the 1945 Year Book. The *Railway Mechanical Engineer* presents abstracts of some of these reports and of addresses by the officers in the following pages:

Address by President Cheshire

The coveted status of a civilian permits me to assume again the duties incumbent upon your president. It is indeed a privilege to be back among you and have the opportunity to sit down with the officers, and other members of the General Committee, to review the field of activity and jointly to high-light those problems demanding the qualified attention so essential to continued and substantial progress.

I would be remiss in a privileged duty did I not commend your other officers, for the competent way in which they have carried on through the war years. This has been accomplished at no little personal sacrifice, but nevertheless with characteristic devotion in maintaining a body of car men in association, to meet the challenge of new problems in post-war transportation.

The great handicap under which your association labors is that which has been imposed by the war since 1941, namely, no annual meetings. More recently, the inability to hold even committee meetings has adversely affected subject development.

Were it not for the help of *Railway Mechanical Engineer,* again made available as a "Convention in Print" issue for November, we would indeed be mute, except for our own published formal proceedings. It is largely through the cooperation of the railroad technical press and the active assistance and encouragement of members of its editorial staff that the spark of association activity has been preserved.

Just now, there is every indication and every reason to believe that rail transportation stands in the early days of a decade of unequalled challenge. Precedent must give way to qualified initiative. Traditional design must undergo critical review impelled by the force of unparalleled competition. Established practices need a clinical examination and rigorous treatment.

To do these things as rapidly and as well as they must be done will require the enthusiastic, concerted efforts of the best men in the field. This, will require meetings, discussions, conferences, conventions and action. Accomplishment will require development, assignment, direction, energetic service and some personal sacrifice. It is with confidence I assure you that your officers are bent upon providing the executive and administrative effort requisite to a dynamic program of improvement in rolling-stock maintenance and maintenance practices. However, acceptable progress on such a program will be achieved only by individual activity of the membership. To those receiving committee assignments likewise comes the individual challenge to contribute by interested activity. Without this, the very premise of the organization is denied—association. Association of ideas; association of activities!

The committee reports here included are limited by all of the interferences imposed by the European and Japanese wars and the distraction incident to their prosecution. Your officers are preparing for an early start in 1946 on a program of challenging activities and many of you will be named to various committees. The progress of each such committee will be measured by the varying degree of individual activity. Those who are not named to committees are urged to contribute to individual committees their experiences, ideas and recommendations. By doing this, the committee reports will be finally representative of the best collective experience.

Be assured we look forward to a climax of the 1946 activities in a convention meeting in the early fall of 1946. Your officers intend that it be one of unequalled contribution to the art of rolling-stock maintenance and maintenance practices. Your individual interest and activity is necessary to that end.

Address by Vice-President D. J. Sheehan

Victory, Success and Accomplishment: Since the last annual *Railway Mechanical Engineer,* "Convention in Print" we have, in this country, tasted victory; for which we are all thankful and proud. We, as members of the

*Reference to the sudden death of Mr. Krueger on October 13 appears on page 568 of this issue.

Car Department Officers' Association rightfully feel that we have been successsful in our particular part which has been vital in achieving that victory. We have accomplished a great deal, and at the present time we must realize that in order to reap the benefits of victory and successs, we must continue in our efforts towards accomplishment.

Last year, I appealed to the membership to assist in giving the officers and chairmen of the committees the benefit of their individual thought on the subjects that they would like to have discussed and the discussion of which would help in the more effective performance of car department work. The response during the year has been encouraging, even though the volume of the response has not been large. I would continue to urge the members of this association to offer suggestions for subjects which might be beneficial to them and to other members of the association. A great many new problems are being introduced in car departments of the railroads of this country at the present time and they are problems which many of us are endeavoring to solve. It is my hope and desire that, when we meet at our next convention, we will have an opportunity to discuss and propose solutions for many of these problems.

My attention has recently been called to a method of making repairs to light bad-order cars, which is being tried on several railroads and which is known as the "spot repair system." On some railroads a practice is being inaugurated to set up a repair facility which will cover all work done on light bad-order cars in a space which can be occupied by as few as 12 cars at one time. The cars are moved by means of a car mover onto these spots where all the work is completed, the cars then moving off this spot ready for handling into the classification yard. This method appears to be most interesting in that it affords the possibility of segregating all workmen, materials, tools and supervision in a small area. It is hoped that this subject will be handled by committee and presented at the next annual meeting.

A great many freight-car repair tracks are making use of mobile equipment such as cranes, tractors, lift trucks, trailers, etc. The handling, care, maintenance and upkeep of this equipment presents a new problem to car-department officers. It is hoped that one of your committees will, during the next year, make a study of various means of solving this problem and that, at our next meeting, details will be presented.

With modern trends and the necessity for increased efficiency in handling materials on repair tracks, there are many innovations in material control and deliveries. This subject will also receive consideration during the ensuing year.

My attention has recently been called to a new and unique method of handling unmounted wheels. A comprehensive study of this subject and development of the advantages and limitations of various methods of handling car wheels, both mounted and unmounted, would be most helpful.

My purpose in mentioning these few items is to appeal to our membership to offer their services and their experience on subjects of this kind to your Executive Committee and the committees to whom these subjects will be assigned. It is difficult for the Executive Committee to know which of its members have had actual experience with some of these problems and we would most heartily welcome the thoughts, experiences and suggestions of any members who are familiar not only with the problems stated above but any other problems which confront the car department officer in his daily tasks.

May I offer the sincere appreciation of the officers of this association for the assistance that has been given them during the last year by individual members and

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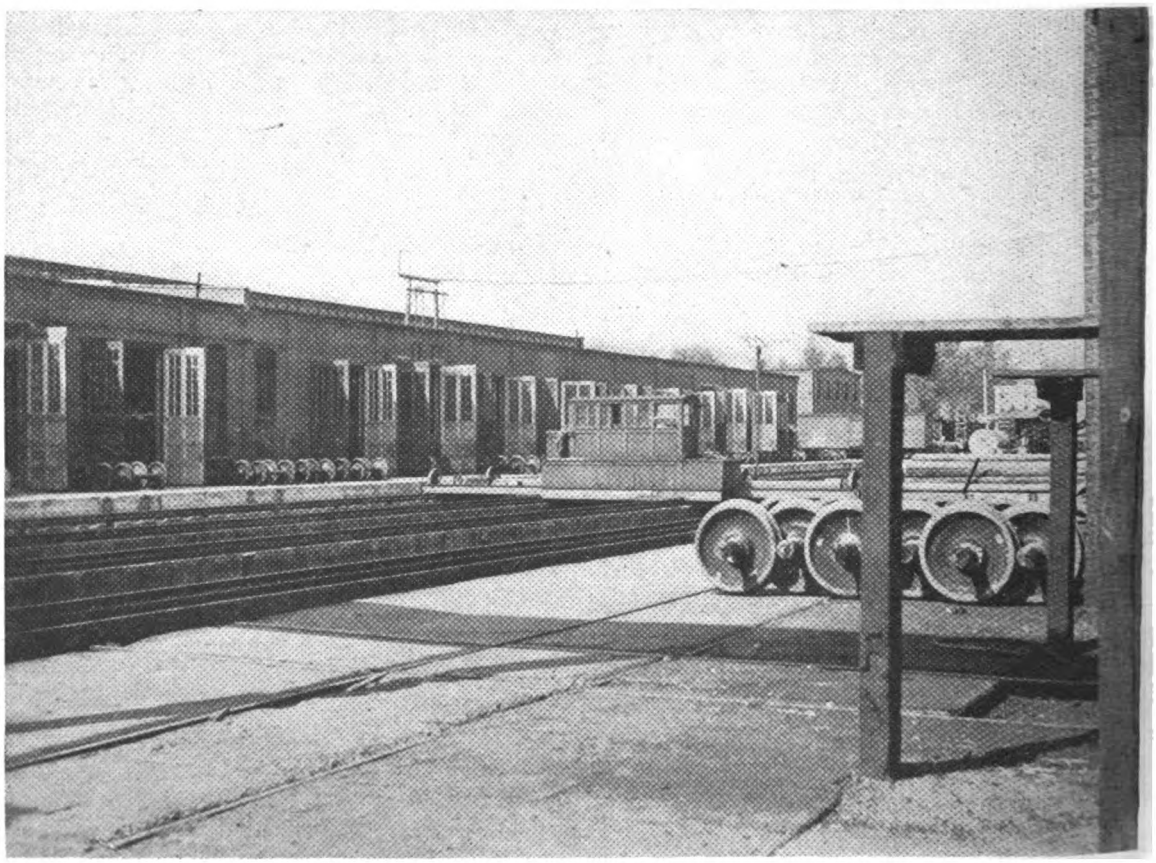

Lt. Col. F. E. Cheshire

A. J. Krueger

Officers
Car Department Officers' Association
1944-45

President: *F. E. Cheshire, division master mechanic, Missouri Pacific, Osawatomie, Kan.*

Acting President: *Albert J. Krueger, general superintendent car department, New York, Chicago & St. Louis, Cleveland, Ohio.*

Vice-President: *G. R. Andersen, assistant superintendent car department, Chicago & North Western, Chicago.*

Vice-President: *D. J. Sheehan, superintendent motive power, Chicago & Eastern Illinois, Danville, Ill.*

Vice-President: *I. M. Peters, secretary and superintendent, Crystal Car Lines, Chicago.*

Vice-President: *P. J. Hogan, supervisor car inspection and maintenance, New York, New Haven & Hartford, New Haven, Conn.*

Secretary-Treasurer: *F. H. Stremmel, assistant to secretary, Mechanical Division, A.A.R., Chicago.*

G. R. Andersen

D. J. Sheehan

I. M. Peters

F. H. Stremmel

P. J. Hogan

the committees who have prepared the papers and contributions essential to the continued success of this organization. I sincerely hope that this co-operation will be continued so that we may profit by the peace which is ours and the success which we have achieved, which should spur each of us on to further accomplishments.

Address by Vice-President P. J. Hogan

During my several years of service as car department supervisor, and like others employed in a similar capacity, a part of my duties require a personal contact with shippers desiring to forward, by rail movement, various types of lading used in the construction and manufacturing field such as rotating machinery, tanks, transformers, piling, girders and other items too numerous to mention.

Loading of such material on flat or in gondola-type cars requires a careful inspection as to the design, stability and condition of the lading prior to loading on the type of car best suited for movement to destination.

In addition, the best method of securement to the carrying-car floor, the weight, length, height and width of lading has to be obtained and forwarded to the clearance engineer for clearance authority from point of shipment to destination in order to prevent the possibility of fouling structures along the right of way or rolling stock on adjacent tracks.

After the commodity is loaded on the carrying car, the car foreman or car inspector advises the shipper of the proper loading method in accordance with the A.A.R. loading rules. In cases of unusual type of shipments in which the rules do not apply, a careful study is made as to the proper securement and distribution to avoid failure enroute.

In cases where the lading is of excessive dimensions and cannot be loaded on the regular type flat or gondola car, our transportation department is advised and requested to provide a drop-frame-type or well-type car, depending upon the type of lading.

Shipments which cannot be moved in regular high-speed trains due to excessive dimensions are handled in local service and in many cases move via circuitous routes where structural clearance is sufficient.

As the representative of a carrier operating in a thickly populated area and where clearance problems are a daily occurrence it has been my duty to train car-inspection personnel in making clearance information to suit clearance engineers' purposes.

A single 10-in. by 18-in. blueprint has been prepared on the New Haven showing the dimensions necessary for the passage of over-dimension closed cars and loads on open-top cars. Spaces are left in dimension lines, both width, height and length at all critical points so that the inspector can easily measure an actual load, fill in these dimensions and forward them to the clearance engineer's office at New Haven, Conn. Upon receipt of the dimensions, clearance engineers specify the route, restrictions etc. In accordance with instructions from the clearance engineers, three excessive dimension cards are filled out for each individual shipment, with one card attached to each side of the carrying car and, as an extra precaution, it is mandatory on the New Haven that a card accompany the way bill.

In cases where special restrictions are necessary due to close clearances, clearance engineers advise the transportation department as to the restricting points along the route and they, in turn, issue instructions to the superintendent in charge of the territory involved so as to avoid any possible chance of error in movement.

In accordance with the A. A. R. rules, railroads originating excessive dimension loads on open-top cars are required to measure such lading and check the figures against the clearance routes over which the shipments are destined, and if found to exceed the authorized figures as shown in "Railway Line Clearances," such loads must be held for clearance authority from the railroads involved in order to avoid unsafe practices.

Address by Vice-President G. R. Andersen

The war is over. What now? As we reminisce and recall many of the problems with which car-department employees were confronted in their endeavor to maintain both passenger and freight equipment in a condition that would minimize complaints and failures, it cannot be denied that they were many and varied. The necessity for utilizing every possible passenger and freight car

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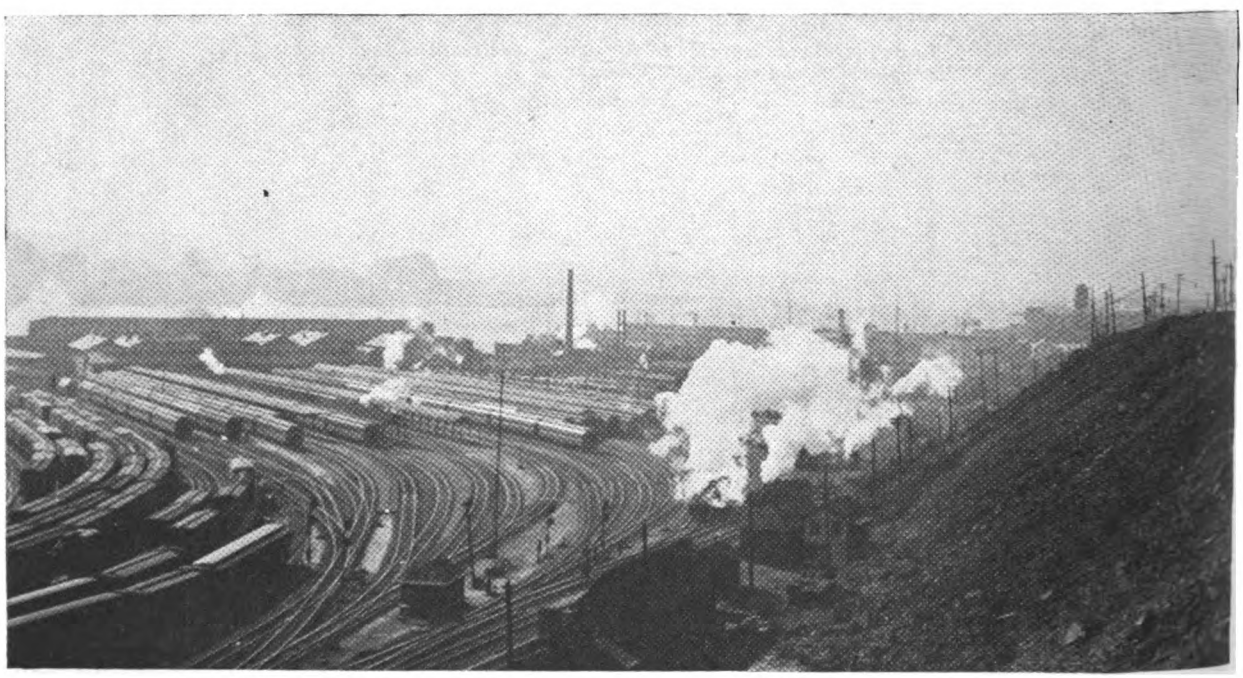


ressed into service equipment that ordinarily would ave received general repairs, or perhaps been retired rom service. The demand for men to fight our battles ikewise removed from railway service many fine prac- ical car men whose absence was felt beyond measure.

These two conditions set up a situation that required ll the ingenuity that the remaining car men throughout he country could muster. That they met many trying onditions and obstacles well is reflected in the operation. The pressure is off—we sigh with relief, and thank the owers that be that the struggle ended before the situation ot beyond control and interfered with the safe trans- ortation of troops and munitions.

What now? From the fight for victory, we revert to he fight for the survival of the fittest. Competition gain enters into the picture, and that is as it should be. In order that we may transport the public with the 'greatest of ease," passenger cars must be rehabilitated; hat is, such cars as are of an age, design, and possess refinements that are worth the expense involved. Stream- line equipment must be purchased in an endeavor to retain at least a good share of the traveling public's patronage. Freight-car equipment will have to be built, rebuilt and retired. The rebuilding must of necessity be done economically, and consequently facilities and tool equipment must be improved. Good judgment will have to be exercised in the retirement of cars and the reclamation of serviceable items from such cars.

The rehabilitation period cannot lag—it must be programmed with reasonable speed in order that the anticipated demands of shippers for the prompt handling of their freight may be met. We enter this period with the man-power situation still far from what it should be; with certain materials still difficult to obtain; with modernization of shops in the plan period, or, if approved, awaiting the availability of help to do the job. So, all in all, mechanical-department officers still have a job confronting them. That they will carry out this assignment to the satisfaction of the officers of the railroads they represent may be depended upon.

L. A. Hartz
Chairman

Painting Now in Transition Period

Value of substitute materials now being appraised—Poor ones being discarded—The variety of colors on freight cars will increase

As a result of great efforts put forth to win the war, no industry has been placed in a more harrowing position than the paint manufacturers. With the curtailment of oils, pigments and resins, many materials were put in use which under ordinary conditions would not have been considered. Some of these materials are still in service and doing a good substitute job, while others have fallen by the wayside never to be resurrected.

We are now in the post-war period and, as we scan the field for probable new materials, we are confronted with the question, What will be offered that will make railroad equipment look better and last longer than the materials in use prior to the war?

From what can be learned, the oxides will predominate in primer coating materials. Alkid resins will be the base materials used in the finish coats.

Much has been said about fast-drying primers and finish coats. Like other materials, there must run through a time-proven method of testing in actual service to demonstrate their dependability and usefulness.

The testing of new materials by the use of accelerated weatherometers has, in some cases, been found wanting, as compared with tests made of materials in actual service. In some cases, these instruments are accelerated to such a high degree that the purposes of a fair test are defeated, and again some materials have been tested in these instruments and passed on to the user apparently with time limit to spare. After five or six months in actual service, these materials have broken down completely, thus leaving us with one proved theory, that mother nature with her elements can and will give us a real test.

Each year, the railroads spend large sums of money for material and labor to paint and keep their equipment in a presentable and protected condition, not only to attract the shippers and traveling public, but to get all possible service out of their equipment.

Much has been said for and against the sandblasting of steel parts on this equipment, but to date no method has been offered that can displace this system of removing rust, corrosion and mill scale to produce a perfect surface for paint adhesion.

Painting Freight Cars

The painting of freight equipment has been done in much the same manner for a number of years, each railroad having its own specifications and formulas for the primers and paints to be used. These specifications and formulas vary and depend on climatic conditions in the different parts of the country through which equipment passes, and in many cases on the commodities transported.

Much has been said for the use of better-grade exterior paints on freight box cars and this seems to be a general trend. Some roads are discontinuing the use of black paint on gondola cars, while other railroads are contemplating painting certain series cars to conform to the colors of their new Diesel freight locomotives.

Without a doubt many changes will be made in the color painting of all freight equipment. With the proposed increase in speed, tendencies may run from drab to bright colors, not only for reasons of public safety, but for the advertising features involved in changes of this kind.

The chairman of the committee which submitted this report is L. A. Hartz, foreman painter, Ill. Cent.

H. A. Grothe,
Chairman

Welding in Passenger-Car Maintenance

A catalogue and discussion of many repairs which can be made advantageously by welding —These include repairing broken castings and restoring damaged exteriors and worn parts

The object of this report will be to point out some of the uses that are being made of welding to attain economy and time saving in the repair job, and an improvement in serviceability and appearance.

Body Side and End Sheets

Side sheets are secured to the body frame with rivets or screws on equipment built prior to the advent of the welded car about 11 years ago. Corrosion and damage requires renewals in whole or part, according to inspection. Some railroads in such cases follow a partial renewal program. Sheets found in good condition are left intact, while individual sections, or parts of sections, are renewed and the new sheet welded in place. This practice would eventually result in a car with the surface free of rivets. During the interim, the physical condition will be kept good, the expense at current minimum and the combination of riveted and welded sheets satisfactory from an appearance standpoint.

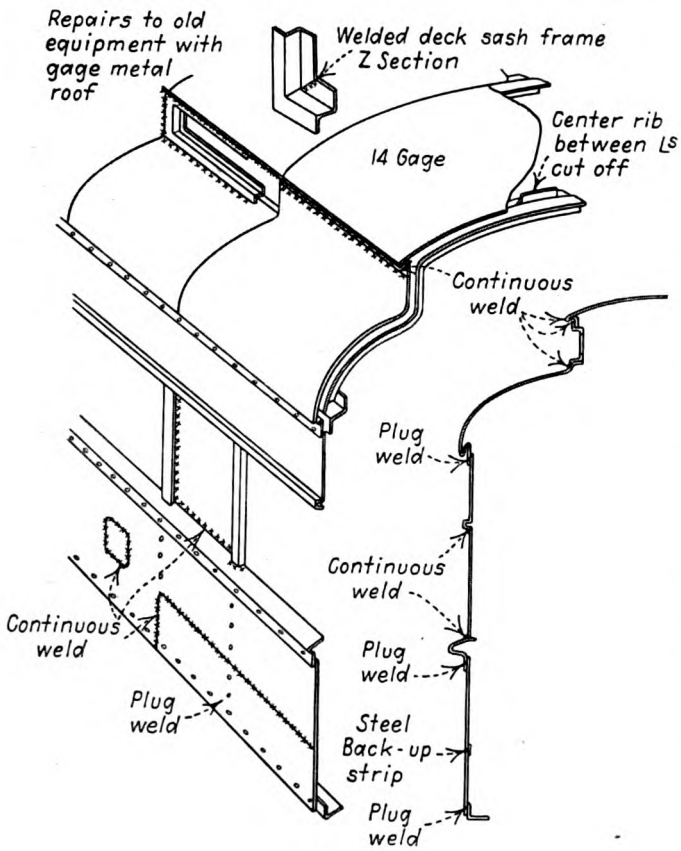


Fig. 1

Fig. 1 illustrates the method and the effect of this transition. It is desirable to extend the length of the new insert from post to post when the section to be patched approximates this length. This permits an easily performed butt weld to the adjoining sheet, and the metal post provides a substantial back-up for the weld seam. In application of multiples of such length, the intermediate posts become the backup for plug welds made in holes punched in the patch sheet before placing in position. The patch sheet need not necessarily be the full height from side sill to belt rail, but may be only that part which requires renewal. In such case, it is practical to install a horizontal backup plate, tack welded in place to the inside of the remaining sheet section.

Cutting out may be confined to small areas, when dented or punctured, and in welding in a new insert various obvious methods are employed to hold the new piece in place until it is welded securely.

Care must be exercised to perform the welding with a minimum of buckling from heat generated in the process of fusion. Selection of the proper welding rod and machine controls, together with step welding, will usually be adequate safeguard. Excessive buckling, if encountered, may be reduced by stretching the affected portion by application of highly-concentrated heat to the inside surface, employing the electric arc for the purpose.

The question of fire hazard is involved in the performance of the operations described, where there is flammable insulation. It is answered by drilling holes in the sheet or section to be removed and soaking the insulation with water. The acetylene torch may then proceed with the cutting operation. Later the insulation is replaced with a non-inflammable type. Before the new sheet section is welded in place the weld seams are backed up with sheet asbestos which, of course, remains in the car walls. To complete the job, weld seams and plug welds are concealed by restoring a smooth surface with a disc grinder.

Posts and Sills

Metal body corner and vestibule posts, window sills, stops, and letterboards are all subject to splice, patching

ır complete renewal by electric-welding procedure, hough originally secured with rivets or screws.

On account of severe exposure to moisture, the lower ıart of metal side posts on express cars are found badly leteriorated from corrosion to a point about 3 in. above he floor. Frequently, a corresponding condition exists n that section of the side sheet which may be repaired

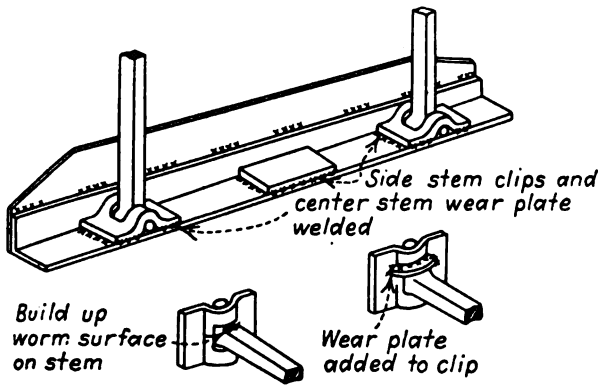
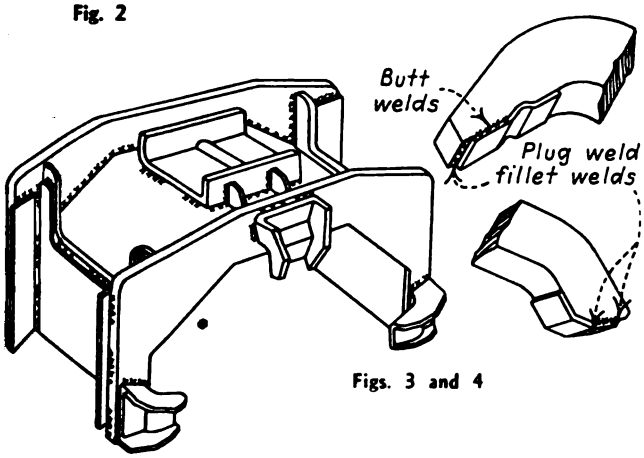


Fig. 2



Figs. 3 and 4

as previously outlined. The defective portion of the side post is cut off and replaced in kind except that to the bottom of the new piece a substantial flat bar has been welded. This permits an enlarged welding connection to the side sill where ordinarily some pitting has developed. The junction of the old post and the new extension may be reinforced with an angle of suitable length and welded.

Car Roofs

In the renewal or patching of roof sheets on cars with roofs of the turtle-back type the procedure is similar to that for side or end sheets.

The older type roof with clerestory, and originally provided with roof-sheet caps and soldered seams, may have roof sheets renewed or partially renewed employing arc-welded instead of soldered seams. Economy in the repair job will be effected, and superior service may be expected. See Fig. 1.

The top roof sheet, if 14-gage material is used, may be butt welded to the adjacent sheet. The metal carline will be the backup, but first the center rib, or projection for the former cap, must be cut off with a torch. If it is decided to retain the lighter 22-gage as the standard, then a lap joint would be essential to permit a satisfactory weld.

The side roof sheets may be of the one-piece or the two-piece type. The one-piece sheet is used when no side-deck openings are present. In this case, the sheet installed extends from the top roof sheet, to which it connects with a continuous weld, to the side plate. At the latter it terminates in an inward bond. This hook engages a separate J-shape of heavier material. This inverted J-shape is then plug-welded to the side sheet at the side plate.

The two-piece-type application for the side roof is required when side-deck openings are present. The same connections at the top roof sheet and the side-plate J-shape are provided as for the one-piece sheet. The junction of the two sheets is made at the lower side roof member. The welding of this seam is contemporary with the introduction of a deck-sash frame constructed of welded sections, and with continuous weld to make waterproof. Asbestos paper is used at joints when the welded seam is to be made.

Underframes, Buffers and Diaphragms

A. A. R. practice outlines standard methods of repairs by welding to underframes. End patform and draft castings formerly scrapped when broken are now repairable. In most cases, forged sections are welded into these as reenforcement or as substitute to sections so badly damaged as not to be restorable in the original.

Considerable welding may be performed to advantage in connection with buffer repairs. Worn side stems may be restored with welding. It is advisable to incorporate a flat plate welded to the clip to effect an increased bearing area, thereby controlling the wear on the side stem. See Fig. 2. Welding at the clips, and of cover- and faceplates to the angle plate eliminates rivets and their upkeep. Clearance of $\frac{1}{8}$ in. for center buffer stems may be controlled by welding into the pocket a U-shaped liner of appropriate thickness.

Trucks

Arc welding is important in repairs to car trucks. Worn surfaces on pedestal legs are built up. Pedestal and roller-bearing outer-housing liners are held in place with welding. Chaffing plates on bolsters and wear plates on cylinder levers are installed with welding. Fractures are repaired and re-enforcements added according to approved practice.

In addition to repairs to roller-bearing housings, elec-

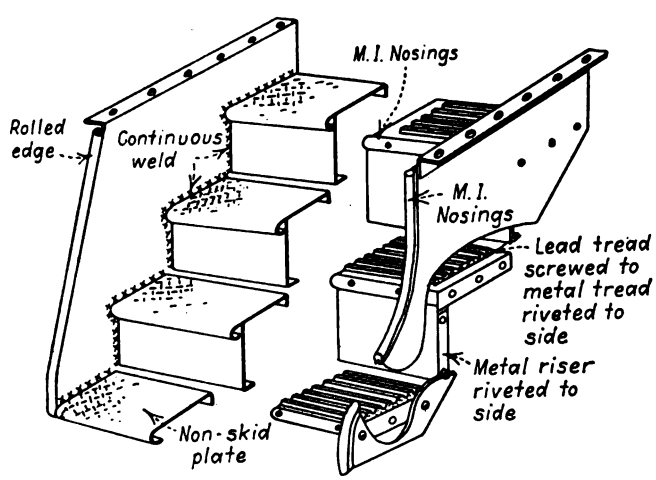


Fig. 5

tric welding has permitted the design of a successful saddle-type outer housing, illustrated in Fig. 3.

Wear pads on the equalizer foot, favor economy and safety and may be attached with electric welding, being careful to restrict welding from the critical zone. Fig. 4 illustrates suitable pads of No. 1020 carbon steel, and method of application.

Vestibule Steps and Platform Floors

When wooden or old-style steel vestibule steps require excessive repairs, consideration can be given to replacement with an all-steel welded design similar to that illustrated in Fig. 5. One advantage is the simplicity of construction when compared with the old style having numerous pieces riveted, bolted and screwed together. The treads of non-skid steel plate have proved satisfactory. Another advantage is the provision of a substantial member to which to attach the uncoupling rod bracket and steam valve-rod bracket, also by welding. Steel welded steps, when damaged, lend themselves to simply performed repairs.

Non-skid steel plates for platform floors may be welded in place to save the drilling, tapping and application of screws, which after service are found rusted in to the extent that they require cutting out to remove.

Relatively frequent renewals of under-the-car frame parts of air-conditioning units, which are subject to severe conditions, are perfotmed with facility with the electric arc. Sumps made of Everdur metal may be repaired with welding, as may also the aluminum evaporators.

Supply and battery boxes formerly made from wood, when found beyond repair, may be made of welded construction. If rust-resisting steel is used, they need not be lined.

Consideration should be given, when wood chairs require replacement, to the product available by forming steel tubing and welding it together. The operations are simple and no complicated equipment is required.

Baggage or express-car side doors, when beyond economical repairs, may have renewals made of welded-steel construction that have proven satisfactory.

Electric welding is employed to advantage in repairs to and renewals of sections in dining-car stoves, also in other kitchen fixtures and appointments.

The foregoing report has not attempted to detail all the examples available, but nevertheless furnishes ample evidence of the large variety of uses to which welding is adapted in the maintenance of passenger cars. (The chairman of the committee is H. A. Grothe, shop superintendent, C. M. St. P. & P., Milwaukee, Wis.)

Changes Proposed in the Loading Rules

Most of the proposals involve slight modifications of present wording, or regrouping of provisions—Three new drawings requested

W. A. Emerson, Chairman

The following changes in the A.A.R. loading rules are submitted for your consideration, all proposed changes are shown in italics.

Page 2

Add new sentence to paragraph under the caption "Attention Shippers": Cards bearing advertisements or trademark, or banners, must not be attached to cars, nor to permanent stakes which are a part of the car, nor to temporary stakes supplied by shipper solely for the urose of carrying such advertisements. They may, however, be aplied to the load or temporary stakes used to secure load. *Cards with red printing or red background should not be used.*

Reason: Such cards should be prohibited, the same as railroad cards with red printing or red background are prohibited by Par. (6) in A.A.R. Interchange Rule 36. Their use should be discouraged as much as possible, and, eventually, a penalty for their use should be imposed.

Page 10

Change heading of Item 1 to read: Flat cars with fish-belly center sills and fish-belly side sills, *or flat cars with fish-belly center sills and fish-belly intermediate sills.*

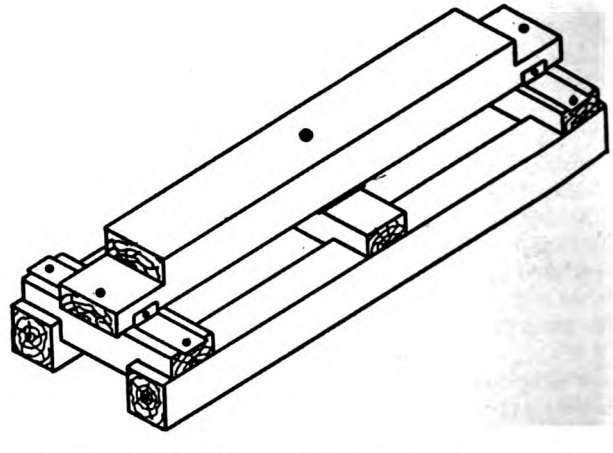
Reason: To include flat cars with fish-belly cented and intermediate sills.

Add new sentence to the heading of Item 4: Fixed end gondola cars. (See diagram below).

Reason: To explain that the diagram applies to Item 4 only.

Page 11

Add new second paragraph to second section of Rule 5: Gondola cars.—Loads not covered by individual figures and where the vacant space across car between the piles and between the load and car sides exceeds a



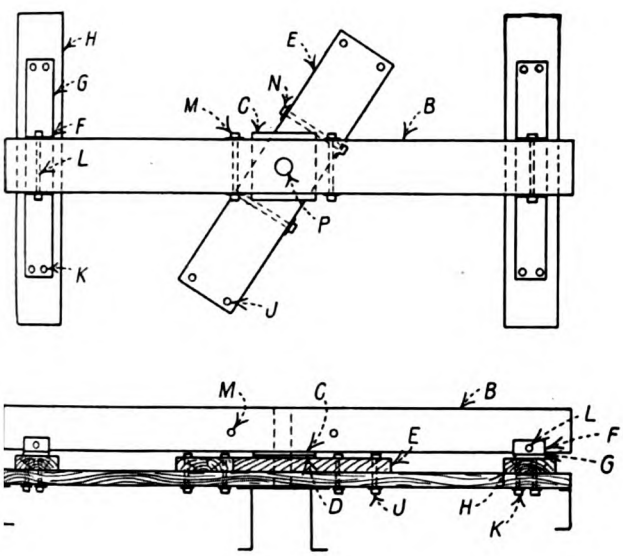
Proposed new Fig. 66-A—This covers the upside down loading of turntables

total of 18 in., must be secured so as to prevent moving or ipping towards sides of car. *Bulk material, such as ore, and, gravel, pig iron, etc., should be equally distributed hroughout the car.*

Reason: To eliminate controversy concerning weight of load between bolsters.

Page 12

Omit last sentence of first paragraph of Rule 9: Bearing Pieces, Sliding Pieces, Clamping Pieces, Braces, Cleats, Wedges, Blocks. Such items must be of hardwood, when specified under the figure, straight grained, ree from decay and strength-impairing knots. Substi-



ite, if desired, suitable metal sections of equal strength; except where metal substitutes are definitely specified. or loading not covered in these detailed rules or figures, ney must be of hardwood. *Bearing pieces under loads equiring the use of more than one car must be secured o as to prevent displacement.* (*Omit this sentence.*)

Reason: The instructions contained in this sentence re provided for in Rule 12.

Transfer the second paragraph of Rule 9, Page 12, to Rule 15, Sec. (a).

Reason: For better grouping.

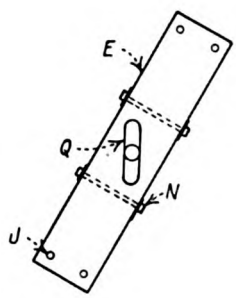
Add new third and fourth paragraphs to Rule 9, Page 12: *When sloping wedges are used for end blocking against vertical surfaces, the flat side of wedge must be placed on floor. Nails or spikes in blocking should be driven vertically to the floor.*

Reason: Wedges with sloping side to floor do not provide full contact with load, and nails or spikes driven vertically to the sloping top of wedge do not provide full resistance.

Page 13

Omit Sec. (a) of Rule 10.

Reason: The same provisions are found in Sec. (d).



Proposed pivoted bolster arrangement for loads on two or more flat or gondola cars

DESCRIPTION	ITEM	NO. OF PCS. PER LOAD	LOAD WEIGHING 15,000 LB. OR LESS PER BOLSTER	15,001 TO 36,000 LB.	36,001 TO 57,500 LB.	57,501 TO 100,000 LB.
Bolster	B	2	8"x 10"x 9'-6"	10"x 14"x 9'-6"	12"x 16"x 9'-6"	14"x 20" or 12"x 22"
Center Plate, Top	C	2	3/8" x 12" x 12"	3/8" x 12" x 12"	3/8" x 12" x 12"	3/8" x 12" x 12"
Center Plate, Bottom	D	2	3/8" x 12" x 12"	3/8" x 12" x 12"	3/8" x 12" x 12"	1/2" x 12" x 12"
Center Plate, Backing	E	2	3" x 12" x 5'-0"	3" x 12" x 5'-0"	3" x 12" x 5'-0"	4" x 12" x 5'-0"
Side Bearing Plate, Top (Bent)	F	4	1/4" x 6" x 1'-3"	1/4" x 6" x 1'-7"	1/4" x 6" x 1'-9"	3/8" x 6" x 2'-1"
Side Bearing Plate, Bottom	G	4	3/8" x 6" x 3'-6"	3/8" x 6" x 3'-6"	3/8" x 6" x 4'-0"	3/8" x 6 x 4'-0"
Side Bearing Backing	H	4	3" x 10" x 5'-0"	3" x 10" x 5'-0"	3" x 10" x 5'-0"	4" x 10" x 5'-0"
Center Plate Backing Bolts	J	8	3/4" Dia., with Washers			
Side Bearing Bottom Plate Bolts	K	16	3/4" Dia. Heads to be Flush with or Below Top of Plate			
Side Bearing Top Plate Bolts	L	4	5/8" Dia.			
Bolster Transverse Bolts	M	4	5/8" Dia. One on Either Side of Center Pin to Prevent Splitting			
Center Plate Backing Bolts	N	4	5/8" Dia. One on Either Side of Center Pin to Prevent Splitting			
Center Pin	P	2	2 1/2" Dia., Long Enough to Rest on Center Sill Cover Plate			
Slotted Center Pin Hole	Q		At one End of Load Only			

All wooden items must be hardwood
Deviations permissible only when specified under individual figures

Transfer Sec. (f) of Rule 10, Page 13, to Fig. 36 on Page 117.

Reason: For better grouping.

Transfer Rule 11, Page 13, to Rule 15, Sec. (b).

Reason: For better grouping.

Page 68

Fig. 5. Include drawing and specifications for pivoted bolsters. (See accompanying sketch.)

Reason: The drawings under individual figures are

indistinct, and, therefore, believed to be the reason for frequent misapplications. Inasmuch as the bolster arrangement in each figure is similar, it is thought that a single drawing, with details enlarged, would simplify revisions of the present drawings, and would provide a clearer understanding of requirements.

Page 186

Fig. 186. Omit "or upside down" in heading, to read: Turntables, Right Side Up, Pivoted Bolsters—Two or more Flat Cars

Reason: Because of the following recommendation for a new Fig. 66-A to cover upside down loading.

New Fig. 66-A. Transfer the first drawing of Fig. 66 to this figure, with enlargements, and add a separate drawing of the pivoted bolster arrangement. (See accompanying sketch.)

Reason: The present drawing is difficult to read, because of compactness. The pivoted bolster arrangement differs from all others, and the details should, therefore, be clearly indicated.

Pages 310 and 314

Figs. 128 and 132. Add a new paragraph, to read: When tanks, etc., which are equipped with domes or other projecting fixtures, are placed on car with such protruding parts located at an angle with the car floor so as to keep the width of load within clearance limits, they must be secured, when necessary, to prevent creeping clockwise or counterclockwise.

Reason: Such material is often loaded with the dome placed in a position about 45 deg. with the horizontal. When not secured, the weight of the dome sometimes causes it to slip downward, resulting in its projecting beyond side of car and frequently exceeding clearance limits.

Page 318

New Fig. 134-A. Heading to read: Long Boilers, Shells, Tanks, etc.—Single Cars, overhanging one or both ends—Flat or Gondola Cars. (Specifications the same as Fig. 134.)

Reason: To provide a figure to cover such loads.

It has been suggested that consideration be given to reprinting the loading rules in either a loose-leaf or pamphlet form for each individual figure, showing thereon all the information required.

Reason: To clarify and simplify reference.

(The report was submitted for the committee by Chairman W. A. Emerson, general master car builder, Elgin, Joliet & Eastern, Joliet, Ill.)

Freight Cars for Scheduled Fast Trains

Competent inspectors should select cars for loading — Condition should insure uninterrupted journey — Lubrication attention of utmost importance

J. E. Keegan
Chairman

With the end of war and return to peace-time operations, the railroads are again faced with greater competition and the necessity for moving freight with the least possible delay. This means that an increasing amount of freight will move in scheduled fast-freight trains and our respective managements will expect these trains to move on schedule. It is up to all of us to get our car-department organizations tuned up to the point where such results will be obtained. They will be obtained only by having cars in such condition at the dispatching points that they will go through to final destinations without delays due to mechanical defects and with minimum delays at intermediate terminals for inspection and lubrication.

The preparation of cars for such trains will require the consideration of several factors—the selection of cars for loading, conditioning of the cars selected, and the lubrication and final inspection in the outbound yards.

The Selection of Cars for Loading

The proper selection of cars for loading is one of the most important of the car inspector's duties and too much stress cannot be placed on the necessity for care and thoroughness. It is hardly necessary to point out the time and expense that would be saved if loaded cars could proceed to their destination, uninterrupted by trips to repair tracks. Experience has shown that most of the loaded cars shopped, have defects that undoubtedly were in existence at the time the cars were loaded and which should have been detected prior to loading. Too often loaded cars are found to be in such condition that repairs cannot be made. This necessitates a transfer of the contents and entails excessive delay, especially at points not equipped for such work. This also may often result in further delays at other terminals, because of the improper loading at the time that the transfer was made.

The first requisite in the proper selection of cars for loading is that the men assigned to this work should be competent and conscientious. They should know what commodity is to be loaded and the type and capacity of the car required. In selecting a car, the inspector should first see that the air brakes and repacking are in date. A thorough inspection should be made of the trucks for defective wheels, journals, journal bearings, truck sides, truck bolsters, spring planks, brake beams, etc., as it is for repairs to these parts that loaded cars are most frequently shopped. Couplers and draft rigging should be examined and of course all safety appliance items. The underframe should be inspected for broken or bent sills, body bolsters and crossties. Flat cars and gondolas

ıould have good floors, particularly if they are to be aded with commodities which must be secured with ›or blocking.

Care should be exercised in selecting box cars so that ıey will be suitable for the commodity to be carried. he condition of the floors, sides, ends and doors are ıportant. Too many cars are shopped enroute, due to efects in such parts, and we have all experienced de- ys and in some instances serious wrecks, due to com- ıodities falling through the car floor, side doors falling ff, etc. Particular attention should be given to the ›ndition of outside posts and braces on single-sheathed ars. Many are found to be broken at the plate or sill nd when cars are loaded, the side sills are strained. 'his causes them to sag and in some cases, to break ı two.

In selecting refrigerator cars for loading, it is essential hat the hatch plugs have a tight fit and are properly ecured to prevent coming loose and falling off enroute. Side doors should receive careful attention, so as to in- ure proper fit and the attachments should be in good ondition in order to prevent doors coming open enroute. On account of the importance of this work, the selection of cars for loading should be done as far as possible dur- ng daylight hours.

There are several practices which should be corrected, if we are to avoid delays to scheduled freight trains on account of defective equipment. First, is the selection of cars for loading by other than car inspectors. Frequently cars are selected by yard masters, yard clerks, members of switching crews, station agents or other employees who do not have the necessary knowledge of what is required. Second, cars are unloaded in industrial plants and reloaded without having any inspection made. Third, in many instances, no attention is being paid by the transportation employees to the commodity classification. A car is a car to them and to avoid switching out of cars, they will place them at industries for loading regardless of their classification or mechanical condition.

All railroads have methods of identifying cars good for the various commodities, and it is up to the mechanical officer to see that cars are loaded with commodities for which classified and that cars are not loaded if they are not in safe and serviceable condition to carry that load to destination.

Conditioning of Cars

Of equal importance with the selection of cars for loading is the conditioning of the cars selected. Cars requiring repairs should be placed in shops or on conditioning tracks and thoroughly gone over. Owing to the demand for cars and the shortage of labor and material during the war period there has unquestionably been a let down in maintenance of equipment and it will require real effort on the part of car-department officers to impress on the minds of the members of their organizations the necessity for rehabilitating freight cars to such point that they can reasonably be expected to carry their loads to destinations without mechanical delays.

While the cars are in the shops for the particular defects found by the inspector, the common defects for which cars are shopped enroute should be checked. Hot boxes are the greatest cause of delays to cars and so the journal boxes, journals, bearings, wedges and packing should receive careful attention. Trucks should be examined for defective side frames, bolsters, springs and spring planks, brake rigging, wheels and brake-beam safety supports. We are inclined to neglect the latter item which is one of the most prevalent causes for freight-car failures—brake rigging down. Couplers, draft gears, coupler yokes, cross keys and retainers, and yoke rivets should be placed in good condition. Defective draft and center sills should be repaired, as should defective doors, floors, safety appliances, etc. Air brakes should be inspected for leaks, defective brake valves and brake cylinders, train pipes, securements and air hose. Piston travel should be properly adjusted and the brakes tested to know that they are in proper operating condition.

Attention to Cars in Train Yards

Cars selected and conditioned for movement in scheduled fast-freight trains, after being loaded, are switched to train yards for placement in such trains. This switching movement to and from loading points often entails interyard moves over humps and sometimes for considerable distances in large terminals. Therefore defects are apt to develop which will cause considerable delay, thereby disrupting schedules. It must be remembered that these trains may well have schedules calling for speeds equaling those of passenger trains and that the equipment must be in such condition that it can withstand these speeds.

This requires a final inspection, air-brake test, and lubricating attention. Journal bearings should be hooked to locate and remove waste grabs that have developed in terminal movement and the journal-box packing should be adjusted and oil added if necessary. As stated previously, hot boxes are the greatest causes of train delays and we cannot stress too much the importance of proper lubrication of cars. We are inclined to pay too little attention to the qualification, ability and training of car oilers and the work performed by them, and the quality of this most important operation suffers as a consequence. We would do well to see to it that the best talent available is employed for the lubrication of freight cars.

Intermediate Attention

Many freight trains travel considerable distances and it is to be expected that some intermediate attention is necessary in order that they maintain their schedules. At such intermediate points, facilities would be provided for adequate fast inspection and lubricating attention. Such facilities as assigned tracks, properly lighted, with repair and lubricating material readily available, inspection pits in yard humps over which cars pass permitting underneath inspection, together with oiling facilities on the humps, are of considerable assistance.

The above outline furnishes a brief description of some of the things that are necessary in preparation of freight cars for scheduled fast freight trains and offers suggestions which we believe will be of material assistance in this important matter.

This report was prepared by the Committee on Freight and Passenger Car Maintenance, comprising: J. E. Keegan (chairman), chief car inspector, Pennsylvania; G. E. McCoy, assistant chief car equipment, Canadian National; W. J. O'Brien, general car foreman, N. Y. C. & St. L.; L. H. Day, superintendent car department, D. & R. G. W.; L. W. Dobbins, general car foreman, N. Y. C.; W. E. Geddes, mechanical engineer, Gen. Amer. Trans. Corp.; H. R. Baker, assistant general car inspector, C. B. & Q.; W. H. Hartnett, general car foreman, C. & N. W.; H. E. Wagner, master car builder, Alton & Southern.

Railway Fuel and Traveling Engineers' Association

The Association continues intensive study of train and locomotive handling and fuel economy

PAPERS and reports on various aspects of fuel economy nd the problems of training locomotive enginemen and remen in the technique of handling Diesel-electric and team locomotives constitute the year's work of ten committees of the Railway Fuel and Traveling Engineers' ıssociation. The annual meeting could not be held beause of wartime transportation conditions, but these reports and three additional individual papers will appear in the 1945 year book of the Association.

Reports were prepared by the following committees: Locomotive Firing Practice—Oil; Locomotive Firing Practice—Coal; Front Ends, Grates, Arches, and Ashpans; Utilization of Motive Power; The Road Foreman and the Diesel Locomotive; Air Brakes—Passenger-Training Handling; Fuel Records and Statistics; Black Smoke, How Can It Be Cured?; and Coal. An individual paper was presented on the road foreman's part in educating enginemen and firemen, and two others were sponsored by the Committee on Coal, one on Colloidal Fuel—Its Development and Uses and the other on Conservation of Coal for Locomotives. The Committee on Front Ends, Grates, Arches and Ashpans presented only a brief interim report. Abstracts of the reports of the other committees and of the individual papers appear on the following pages or will appear in later issues.

W. C. Shove, Chairman

Firing Coal-Burning Locomotives

The essentials of combustion—Vigilance by fireman necessary in controlling the fire—Art of "reading the fire"—Pertinent don'ts

The first essential of firing practice is the preparation of the locomotive for service. Firemen should report at the terminal in sufficient time to make a systematic inspection of the fire condition, grates and tool equipment. It is felt, after trying out the stoker to see that it is operating properly before leaving the terminal, the fire should be maintained in the terminal with the shovel. However, fires can be maintained with the stoker, proper attention being given to the distribution of the coal.

If an engine is fired properly, there are fewer pounds of coal to be handled; little or no necessity for using the rake or slice bar, and cleaning the fire and shaking the grates is reduced to a minimum. A locomotive that is fired properly steams unless there is something radically wrong with it or the coal is devoid of heat units. Even in such a case, proper firing produces the most steam possible under the conditions and the fireman may safely feel that no one could have done better than he did under the circumstances.

Fundamentals of Combustion

In order to fire an engine properly, the fireman need not necessarily know anything about the theory of combustion; he may have learned to apply the principles without knowing the reason for so doing. In fact, many first-class firemen do not understand anything about these principles. There are, however, certain fundamental facts that should be borne in mind when endeavoring to explain to firemen the necessity for doing certain things to get proper results.

To produce heat in a locomotive firebox, three conditions are necessary and only three.

First, there must be a supply of fuel. Second, there must be a plentiful supply of air, and, third, the air and the fuel must be brought together at a temperature at which they will burn.

Soft coal is composed of coke and gases. When coal is thrown on a fire, the gases are driven off by the heat, the coke remaining on the grates. Both the coke and the gases will burn, but before any burning can take place, they must be supplied with air at what is called the igniting temperature. Air is made up of several gases, one of which is the particular thing required for burning the coke and the gases in coal. This burning will not take place until the fuel and the air are heated to a certain temperature, called the igniting point. The fact that air is absolutely necessary for burning can be proved by experimenting with a tallow candle. If the candle is lighted, it will continue to burn so long as plenty of air is supplied to it, but if a milk bottle is placed over the candle it will immediately begin to smoke and the flame will grow long and as soon as the limited amount of air which the bottle contained has been used up, the burning will stop.

If too much air is supplied to a fire, it will interfere with the burning. This can be demonstrated by blowing on the flame of a tallow candle. Blowing easily will not, apparently, reduce the flame very much; blowing steadily and strongly will almost put the flame out, and a sudden sharp breath will extinguish it entirely. The application of this will be spoken of later. The statement that the air and the fuel must be brought together at a temperature at which they will burn can also be illustrated by means of a candle. Before the candle is lighted, fuel is present surrounded by a plentiful supply of air, but the

condition of proper temperature is lacking. The fuel of the candle must first be heated to a temperature at which it will start to burn. When the candle is burning, the action that takes place during the burning supplies sufficient heat to maintain the fuel at the burning temperature. If this condition is interfered with, however, as illustrated by blowing the comparatively cold air from the lungs against the flame, the temperature is reduced below the burning point, the flame goes out, and the burning will not begin again until the temperature has once more been raised to the burning point.

With the three conditions of fuel, air and proper temperature present, burning will always take place, whether it be in a locomotive firebox, in the open air or in the finest home or office, but with any one of these three conditions lacking, burning absolutely will not take place.

When burning does take place the fuel disappears, with the exception of the ash and the dirt that are in the coal and these remain on the grates. This disappearance of fuel is due to the fact that in the process of burning a chemical change takes place by which the air and the fuel unite to form gases. These are drawn out through the flues into the front end and from there pass out through the stack with the exhaust. During this changing process the heat necessary for steam-producing purposes is evolved.

While there are many different kinds of fuel which may burn in many different ways, anyone who thoroughly understands the basic principles set forth above can understand and explain most of the actions that take place in a locomotive firebox.

In describing the actual work of firing a locomotive, it is necessary to assume that the engine is properly drafted and is in proper condition to burn the fuel economically.

The Fundamentals Applied

In starting out, the fireman should endeavor to have a light, level, bright fire. These three conditions should always exist in the firebox. The thickness of the fire should be regulated by the class of fuel, the drafting of the engine, and the weight and schedule of the train.

The fire must be light because the amount of air that can be supplied in a locomotive firebox is always limited. If the fire is too light, the draft will pull such a large volume of cold air through it that the temperature of the gases will be reduced below the igniting point and proper burning will not take place. This condition can be ascertained by observing the fact that the steam pressure immediately falls and no smoke appears at the stack even when fresh fuel is thrown on the fire.

It is not so easy to recognize the condition when the fire is too heavy. Proper results, however, cannot be obtained with a thick fire. It is practically impossible to get sufficient air through a thick fire to burn the large volume of gases that are liberated from the fuel and the result is that when fresh fuel is thrown on the fire, although there is sufficient heat in the firebox to drive off the gases from this fuel, there is neither the proper igniting temperature nor the requisite air supply to burn them. These gases, however, as soon as they are liberated from the coal are pulled through the flues by the exhaust and as the conditions in the firebox have not been such as to allow them to burn and as these gases are the principal heat-producing part of the coal, it will readily be seen that a large amount of heat is wasted.

The fire should be level for the reason that if the locomotive is properly drafted, there is an equal pull of air through the entire grate area, but if the fire is banked at one place and low at another, the air seeking the easiest channel for entrance will, for the most part, pass through the place where the fire is light, very little air passing through the place where the fire is banked. This gives an unequal distribution of air to the fire and creates the same effect on one part of the fire as though the draft were too light, and on the other part as though it were too heavy. This is further and better illustrated in cases where there is a hole in the fire. In such cases, nearly all of the air passes through the hole and very little through other parts of the fire with the consequent result that the steam pressure immediately responds to this condition and the pressure cannot be regained until the fire is leveled over, and the proper conditions for burning are once more obtained. A condition of this kind is very hard on the boiler as well as on the steam pressure.

Firemen should never be allowed to think that the mechanical stoker is anything but a machine that was designed to place an even layer of fuel over the fire bed. It does not know what portion of the firebox is using the greatest amount of fuel, neither does it know where a bank has been started; it is always necessary for a fireman to keep almost constant watch of the fire at all times.

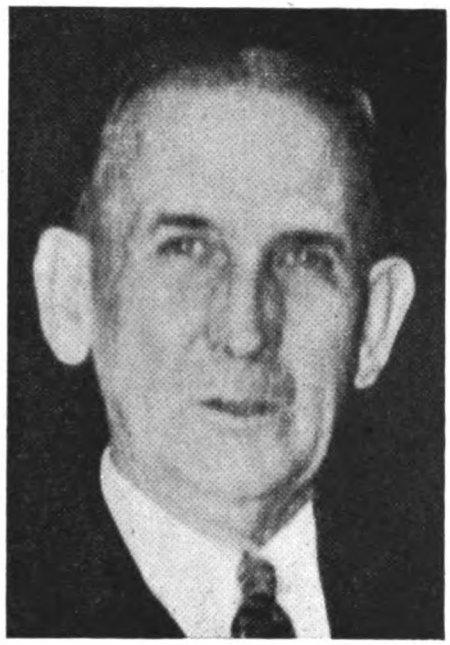
It is a rather difficult matter to so adjust the front-end draft appliances so as to produce an even flow of air through every part of the grate area, which, of course, means the fuel bed also, and as the rate of combustion is proportional to the air flow, it follows that there may be—in fact will be—a difference in the amount of coal burned over various sections of the grate. However, if this difference is only over the front or back sections of the grate—that is, if the engine burns more coal ahead or behind—it is a comparatively easy matter to adjust the rate of firing to meet the need, either with the scoop or by regulating the pressure on the stoker distributing jets where the engine is mechanically fired. Where the engine burns a "spotty" fire—that is, with an entirely different condition, especially where the locomotive is not equipped with a multiple-valve distributing jet where each valve allows the pressure to be manually controlled. In such cases the only recourse is to supply that particular spot where the burning rate is highest with the scoop instead of blowing the coal in haphazardly and trusting to luck that some may fall in the right place.

A somewhat similar condition obtains where, through some obstruction, the air flow is restricted at some particular spot, thus reducing the burning rate at that spot, resulting in the gradual formation of a bank which may in turn result in the formation of a clinker and thus stop combustion entirely at that point. In this case the right thing to do is to shake the grates lightly before the clinker forms and then with the scoop, or by regulating the jet pressure, fire around that spot until the bank gradually burns down. However, if the clinker has already been formed, then there is nothing to do except to try to loosen and up-end the clinker, or, if possible, remove it, and then with the hook spread live fire over that spot and then supply less coal to that point to prevent the formation of another bank or clinker. If a clinker once starts to form and is not broken up at the start, it will continue to grow and ultimately affect the steaming of an engine.

There are several types of stokers now in use that are fitted with adjustable vanes or deflectors. These can be adjusted so as to reduce the amount of coal delivered to either side or either back corner, but cannot be set to reduce or increase the amount of coal delivered to any particular spot in the fuel bed. Therefore, we must either resort to the scoop, or, if the stoker is fitted with a multiple control distributor jet, adjust the jet pressures to deliver coal only to the place where it is needed.

In all cases, regardless of whether the engine is fired by hand or with a mechanical stoker, the fireman should be taught to "read" the fire regularly and often. This is an easy matter for the older and experienced firemen.

E. E. Ramey



L. E. Dix

W. C. Shove

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1944-45

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Vice-President: ***W. R. Sugg, general supervisor air brakes, Missouri Pacific, St. Louis, Mo.***

Secretary-Treasurer: ***T. Duff Smith, 327 South La Salle Street, Chicago.***

ɔut must be learned by the novice. The best method of doing this has been explained in preceding reports, but as these may not be available are here quoted again:

"In order to 'read' the fire, stop firing until the smoke clears at the stack, then open the fire door, turn the scoop over so as to deflect a stream of air over the fuel bed. The dark spots will show where the fire is not burning properly. The bright spots will show where the fire is burning as it should, where combustion is most rapid and where the most coal should be supplied. Now if regardless of all efforts to get an even fire, holes or banks continue to form, the matter should be reported on arrival at the terminal. For instance, if the fire burns spotty, report 'Examine the grate,' but if the fire burns fairly uniform but more at the front or back of the box, report 'Examine and adjust front-end appliances; engine burns too much coal at the front or back (as the case may be).'"

Firing practice as a general thing is developed to the degree that supervision on the respective territories insists upon. If the road foreman, fuel supervisor, traveling fireman, and others supervising the work of enginemen do not insist on the best-known methods of firing practice, the natural trend is for new firemen to drift into methods of their own, which are not in all cases conducive to fuel economy or good practices.

Boiler feeding is an outstanding factor in fuel economy and fire condition. The most economical method of boiler feeding is to operate the feedwater pump or injector continuously, or as nearly so as possible, and adjust the feed according to the condition of the run. It is recommended that on leaving the initial terminals the injector be used the first few miles in preference to the feedwater heater, or until the arch is hot and the fire is set.

In no other situation is close co-operation more important between two persons than between the engineman and fireman in the cab of a locomotive.

An engineman who has been thoroughly schooled in good firing practice on a locomotive is in a position to instruct new firemen in the correct methods of firing practice. Each engineer should take a special interest in educating new firemen.

Safety

Don't forget safety is of first importance.
Don't walk through escaping steam.
Don't walk between moving engines or cars.
Don't walk on tracks without keeping a sharp lookout in both directions.
Don't get off locomotive without looking in both directions.
Don't cross tracks between locomotives standing close together on the same track.
Don't lean beyond line of cab without exercising care to avoid being struck at points where clearances are close, or while passing trains.
Don't jump over storage, ash, or inspection pits.
Don't get off a locomotive face first.
Don't carry grips, clothing or tools while alighting from or boarding a locomotive.

Fuel Conservation Don'ts

Don't leave terminal unless fire is in good condition.
Don't overfill scoop shovel.
Don't allow rock, iron, wood, or other foreign matter to be fed into stokers.
Don't allow safety valves to open unnecessarily.
Don't allow a dirty locomotive deck or apron.
Don't knock coal off by careless handling of tools.
Don't throw large lumps in the fire.
Don't use the blower except when necessary.
Don't permit fire to get heavy or dirty.
Don't "die on a full stomach." Never feed more coal than needed.
Don't allow fire to die out in the forward end of firebox, causing flues to leak.
Don't permit banks to form in the firebox.
Don't leave the fire door open while descending grades or stopping.
Don't shake grates excessively.

Shaking grates is an important factor in connection with good firing practice. Grates should be shaken often enough to keep dead ashes off the grates, not allowing fire to become so heavy that it restricts the free flow of air to the firebox.

No standard can be set up that will apply to all roads under all conditions as to how often and how hard grates should be shaken. This will depend on the quality of coal fired in a given period.

By observing the above we won't make unnecessary dense smoke and will conserve fuel.

The committee consists of W. C. Shove (chairman), general road foreman engines, N. Y. N. H. & H.; H. E. Tewksbury, traveling engineer, Bangor & Aroostook; C. Harding, road foreman engines, L. & N. E.; W. E. Small, chief fuel supervisor, B. & M.; F. X. Jones, supervisor fuel and locomotive operation, Erie; J. H. Simmons, N. Y. C.; H. Morris, superintendent fuel and locomotive performance, C. of N. J.; S. M. Roth, supervisor locomotive performance, W. Md.; C. B. Curtis, road foreman engines, R. F. & P.; W. R. Sugg, general supervisor air brakes, Mo. Pac.; H. T. Clark, supervisor of locomotive operation, B. & O.; A Baxter, D. & R. G. W.; W. E. Beaver, general road foreman engines, Southern; R. A. Reeder, superintendent fuel and locomotive performance, Reading; J. W. Crawford, road foreman engines, Wabash; and J. Mattise, general road foreman engines, C. & N. W.

S. A. Dickson, Chairman

Report of the Committee on Coal

Reiterates recommendations which have been offered on previous occasions looking toward standardization of coal sizes by the mines

[In addition to its own report, the committee contributed two papers, one on "Some 1945 Ideas about the Use of Coal for Locomotives," by J. F. Barkley, Chief of Solid Fuels Administration for War, U. S. Bureau of Mines, and the other on "Colloidal Fuel—Its Development and Use," by D. W. Machin, combustion engineer, Pittsburg and Midway Coal Mining Company. These appear separately.—EDITOR.]

The general impression seems to be that the prevailing general coal shortage will extend well into 1946. The war and all of its disturbances seems to have given birth to the idea that the railroads can take care of themselves with varying kinds and qualities of (mostly) low-grade coals. But, beginning at some time after the war is over, an accelerative competitive condition will doubtless occur in transportation, with new efforts on the part of railroads to gain better efficiency and reduced costs. This will likewise doubtless manifest itself in continued efforts to further develop a standard design of motive power other than the steam locomotive. This committee believes the coal industry will maintain or decrease their sales of coal for locomotive use dependent largely on their efforts and ability to keep their costs, and selling prices, down and to furnish a uniform high standard of preparation, sizing and quality of coal, and also to supply their best research on coal and combustion problems in co-operation with the railroads. In other words, they must forget the past and realize there is serious competition for them, which has to be met, not ignored or dodged.

Fuel problems on the railroads are important, as we ıave been asked by those in authoritative places to make ıs good use of fuel as possible, so that more of it would ıe available for other uses. The disadvantages of using :oal of inferior preparation on locomotives are so obvious ıs to scarcely call for explanation. Not only does it take nore coal with the new men we now have in service, but n many cases it slows up the movement of power, which s important, because if ever the railroads needed to move rains expeditiously, it is now. Also economy in fuel ısage, because of the demand being greater than the upply, is more necessary now than ever before. It is lifficult to maintain motive power up to the same standard .s in normal times and this, too, is a factor, so that put- ing the three factors together—namely, fuel, new men, nd motive power which is not up to par—you have a ombination of conditions that makes it difficult to ontrol present-day problems.

There is a program of research bearing on the develop- nen of a modern, more efficient coal-burning locomotive hat is being participated in by the railroads, the coal ndustry, locomotive builders, electric companies, machin- :ry and boiler makers. The fuel people with each rail- oad are conversant with this progressive program. We uggest that all consistent avenues of thought be put nto it.

Standardization of Coal Sizes

There are a great variety of sizes of coal screened)y a multitude of coal producers. Many railroads tra- /erse two or more coal-producing districts. The mines ıre likely to produce as many as twenty different sizes. In some situations there are likely to be a half-dozen lifferent sizes of slack, for instance—everything from ⅛ in., ½ in., ¾ in., 1 in., 1⅛ in., 1¼ in., 1½ in., and so on—and egg coal, for example, somewhat the same way. This is all a pretty deep subject, but shouldn't the :oal producers get together and stabilize this?

Repeated recommendations have been made with refer- :nce to sizes, as follows: Two-inch minus for stoker use; four-inch minus for hand-fired locomotives, with the further recommendations that adaptability and perform- ınce of the coal be the first determining factor; then, secondly, the methods of production, coal preparation ınd cleaning used by the producer of the coal.

Stress the desirability of co-operation and a broad- minded attempt to have the coal producer understand the railroad's problem and build up an idea in his mind that here is a partnership angle to the production and use)f coal by the railroads. This is an obvious proposition :o all who will think of it and there is a serious postwar :ondition to be taken care of by the coal companies and railroads; first, for the coal man, to hold his market for :oal consumed by railroads as against competition from)ther fuels and other forms of transportation, and also for the railroad to get the cheapest form of power from :oal. Let it be our aim to try to help this situation in every way we can.

[The report included an extensive discussion of the minimum essential instruments for use in small stationary)oiler plants to provide the most effective control of the efficiency of plant operation without involving too great :xpense or complexity of control. This section has been)mitted from this abstract.—EDITOR.]

Uses of Northwest Coals

On one division of a western railroad Montana coal is ıised in freight and yard service. The analysis of this :oal approximates the following:

Moisture, per cent	3.75
Volatile, per cent	30.19
Fixed carbon, per cent	43.21
Ash, per cent	22.85
Coking	Semi
Sulphur, per cent	4.28
B.t.u.	10,070

The coal will not always run 10,070 B.t.u. or 22.85 per cent ash. The ash will run much higher and the B.t.u. lower. This coal is rather hard and often will contain considerable amounts of sulphur balls and bone coal.

This type of coal will steam well if engines are properly drafted and the ashpan construction is arranged to give a good free volume of air under the grates and is made as large as possible to hold a large amount of ash. It has been their experience on large power and heavy freight tonnage that 75 miles is about the limit for holding ashes in the pan. The fire will have to be shaken down about every 15 miles or the firebox will become badly filled up with ash, resulting in excessive fuel consumption and poor steam.

If this Montana coal is handled properly, the fire will give very little trouble from clinkering. The nozzle tips are reduced from ¼ in. to ¾ in. smaller than on engines burning fuel oil or Eastern coal.

On one district of 156 miles a coaling station is 75 miles from the terminals and at this station there is a mechanically operated ash pit so that pans and fires can be cleaned quickly. On engines handling such excessive ash, there must be an efficient swipe to clean out the side and keep the air openings free of ash under mud ring.

Whenever the ashpan has to be dumped between coaling stations, it is the practice to cut off the engine, pull into a passing track, open the ashpan hoppers, and swipe out the pan clean. Pans are never opened up while running on main line; all ashes must be dumped in passing tracks.

In power plants where Montana coal is used the ash problem can be handled by a mechanical ash-conveying system and suitable stokers.

In stationary plants where this type of coal is pulverized, the temperature of the fire becomes considerably higher and much slagging takes place on the water tubes and side walls. Where boilers are being forced to a high per cent overload, slagging becomes excessive. When this coal is hand fired and handled properly, not using the hook in trying to break up a green bank of fuel in the firebox, the coal will not clinker, but if the fire is very hot and the hook is used, clinker formation becomes excessive.

North Dakota Lignite Coal in Power Plants

North Dakota lignite is not used as locomotive fuel but is used in two large stationary plants where direct steaming is used throughout the enginehouse. Each one of these plants produces 25 to 30 million pounds of steam per month.

The lignite coal itself has a high percentage of moisture and will give the best results when fired wet. Over a chain grate stoker it will have ample time to dry out sufficiently to give proper combustion. When this coal is fired dry that fly ash formation on the side wall of the furnace will become excessive.

North Dakota Lignite Coal as Locomotive Fuel

A western railway in 1935 ran some tests with a 2-8-2 type locomotive. It carried 175 lb. steam pressure, had 28-in. by 36-in. cylinders, and developed 53,000 lb. tractive force. It carried a seven-row sealed arch and was equipped with Cyclone front end with opening toward the flues. The stack was 18 in. in diameter and had an

extension 20 in. in diameter which reached to within 17¾ in. of the exhaust nozzle. The ⅜-in. round-hole grates were fired by a BK stoker with a special distributing plate. The capacity of the tender was 12,000 gal. and 16 tons. The standard nozzle for this class of locomotive with conventional front end is 6⅛ in. open and with Cyclone front end, $6\frac{5}{16}$ in. open.

The grates used on these tests have eight rows of ⅜-in. by ⅝-in. round holes and have 20 per cent less air opening than the standard ½-in. round-hole Rosebud grates. The edges of the grate bars have an overlapping feature which effectively seals the openings between the grate bars, forcing all draft through the ⅜-in. holes and resulting in very good air distribution throughout the fuel bed.

The eastern coal used on these tests was Pittsburgh No. 8 mine-run, 13,500 to 14,000 B.t.u., costing $4.15 per ton plus 30 cents handling. The lignite coal used was from North Dakota, screened 2 in. by ½ in., 7,000 B.t.u., 6 per cent ash fusing at 2,350 to 2,400 deg. It cost $1.15 per ton.

From tests with the same engine it was found that with straight eastern coal the evaporation was 5.92 to 6.09 and with 70 per cent lignite to 30 per cent eastern coal, 3.71 to 4.12. It was also found that with lignite coal, which burns with a long flame, and a level fire not over 2 in. on grates, steam temperature readings were obtained as high as 698 deg., equivalent to over 320 deg. of superheat. On trips using straight lignite steam temperature readings of 700 deg. and over were obtained.

The engine had a clear stack at all times. The fire, seen through colored glass, appeared to be getting a uniform mixture of lignite and eastern coal from the rundown into the stoker trough and the distribution of coal in the firebox was good; every air opening in the grate could be distinguished. The flame travel appeared to be much longer using lignite than when using eastern coal, resulting in higher superheat due to the flames licking the flues. The fire over the entire grate area was agitated with every exhaust and most of the ash carried out of the stack.

From the test conducted in locomotive service with lignite coal the consumption in tons would be high and to handle such fuels would require coal sheds which would have to be closer together and a greater amount of fuel placed on the tenders.

The committee is composed of S. A. Dickson (chairman), supervisor fuel economy, Alton; G. E. Anderson, general fuel supervisor, Grt. Nor.; W. L. Sheppard, assistant to vice-president, Pittsburgh Coal Co.; J. F. Barkley, chief, Division of Solid Fuels Utilization for War, Bureau of Mines; W. J. Tapp, superintendent fuel conservation, D. & R. G. W.; Joseph Harrington, advisory engineer, Northern Illinois Coal Corp.; A. F. McElhenie, vice-president and sales manager, Pittsburg & Midway Coal Mining Co.

The Firing of Oil-Burning Locomotives

A discussion of the various factors affecting the quality of the performance of oil-burning steam locomotives with emphasis on fuel economy

Frank Kurz,
Chairman

In general, improvement in fuel performance is attained by combination of some rather fixed factors, such as the proper design of boilers, front ends, fire pans and draft openings; applicable factors, such as fuel-saving devices tending to decrease the water rate per indicated horsepower, and, finally, the fluctuating factors, such as locomotive maintenance, train loading, train dispatching and locomotive firing and handling practice.

The conventional steam locomotive continues in use despite low thermal efficiency because of the simplicity of design and relatively easy maintenance, low initial and maintenance costs, and low cost and plenitude of fuel. Conditions obtaining during the war favored improved fuel performance despite the handicaps of relatively poor firing practice by inexperienced men, due chiefly to the large volume of traffic and incidental heavy train and locomotive loading. With the recession of the war effort and the easing of loading restrictions, the true import of fuel conservation will become more and more evident.

To attain this end, of all the several avenues mentioned above, the most important and fruitful source of improved performance will, of course, be proper locomotive firing practice. Fuel oil for some time to come will continue to be purchased under present specifications. Steam locomotives will be somewhat older, but the same general performance of boilers can be expected. It is in the actual use of the oil-burning appurtenances and the co-ordination of the fireman's efforts with the maneuvering of the locomotive by the engineman that the greatest field for fuel conservation lies.

When one considers that of the total heat units in the fuel approximately two per cent goes to heating fuel, five per cent to the operation of boiler feed pump and injectors, five per cent to operate air compressors, 14 per cent or more is lost with gases of combustion, 45 per cent is lost with the exhaust steam, five per cent is lost through radiation, one per cent goes to atomizer, and 15 per cent is lost through internal friction, it is evident that the remainder available for moving the train is less than eight per cent. While every one of the above items constitutes a big subject by itself, it is only the operation of the locomotives and fuel-oil-burning appurtenances which will be the subject of this report.

It is not difficult to start an argument among engine-

ıen as well as supervisors when it comes to proper meth-
ds of locomotive operation and firing. A casual check
f fuel performance will indicate that for a given train
:hedule the fuel burned may vary as much as 20 per cent
rom day to day. Such a variation alters operating costs
ıaterially, especially for locomotives that may burn $100
·orth of fuel per day.

While the engineman is in charge of the locomotive and
hould instruct the fireman how to do his work properly,
: is still a fact that the fireman is the man who produces
ıe steam which the engineman uses. Heavy fuel oils
ıch as used by nearly all oil-burning railroads today
ıust be heated. While the oil may burn at a temperature
s low as 110 deg. F. or as high as 180 to 200 deg. F.,
omewhere between these limits is a temperature where
ıe best and most efficient results will be obtained for a
iven fuel oil. There are enginemen who believe that
elatively cold oil produces the best results; there are oth-
rs who believe that the same locomotive requires extra
ıot oil to obtain the best results. Both cannot be right.
To save fuel oil the temperature that will produce the
ıest efficiency and good operating results should be deter-
nined and maintained.

Where the Fireman Shows His Skill

It is at the firing valve and the atomizer valve where a
:ontinual concentration on the job is necessary for suc-
:essful fuel performance. Fuel is fed to the firebox as it
s burned. To maintain a constant high steam pressure
vhich is necessary for most economical operation of the
ocomotive, the firing valve must be changed with each
:hange of steam demand. Similarly, the regulation of the
ıoiler feed pump or injector should be such as to main-
ain the proper water level. Permitting the steam pres-
ıure to drop, then forcing the fire to regain the pressure
ır letting the water vary up and down is obviously waste-
ful of fuel. The maintenance of uniform high boiler
pressure and proper water level means constant attention
:o duty.

The subject of proper water level is another which fre-
quently may bring argument with men in charge of the
locomotives. However, it is obvious that while ample
water must be maintained in the boiler for safety both on
an ascending or descending grade, it is also necessary
that the water be kept down to a reasonable level. The
relatively small steam space in the modern locomotive
boilers is reduced by high water which also results in the
entrainment of a great amount of moisture in the super-
heater units which results in a drop in the superheater
temperature, depositing scale and sediment in the interior
of the superheater tubes with continued subsequent low
superheater temperatures and incidental superheater unit
failures. Each of these conditions adversely affects fuel
performance. In addition, where water is carried over
in quantities, lubrication in the cylinders is destroyed and
damage to machinery may ensue.

The skill of the fireman is revealed in the operation
of the locomotive firing appurtenances in such manner
that black smoke or, in fact, any smoke other than a light
haze at the stack will be eliminated. Too clear a stack
may indicate excessive air for the amount of fuel being
burned with resultant greater losses through the stack.
The maintenance of proper fire under all conditions will
not only reveal itself in improved fuel performance but
in the reduction of boiler maintenance due to the elimina-
tion or minimizing of high temperature differences which
are coincidental with poor firing.

Mention should also be made of the proper sanding of
locomotives. Soot is well known as having insulating
properties. Periodical sanding of the locomotive flues
will do much toward elimination of losses in the transmis-
sion of the heat from the hot flue gases to the water and
steam.

The Engineman's Part

The skillful work of a good fireman may be nullified
by the less skillful operation of the locomotive by the en-
gineman. The avoidance of unnecessary speed fluctua-
tions which involve train acceleration or deceleration is
necessary to improve fuel performance. The extra en-
ergy required to accelerate the train is all dissipated
through the heat at brake shoes when the brakes are
applied.

It is obvious that undue train interferences, which are
regulated by train dispatching, and other unnecessary
slow-downs from high speed always mean that more fuel
must be burned to regain the speed, all having an adverse
effect upon fuel consumption. All extra stops and delays
reach back into the fuel tank.

The skill of the engineman is also reflected in his abil-
ity to get the best combination of throttle and cut-off. It
is well known that cut-off is lengthened to increase the
power and shortened as speed develops. For a given
condition there is a best setting for the throttle and re-
verse lever. While the engineman depends to a great
extent on his experience and the feel of the engine, it is
obvious that in this regard individual enginemen do not
always agree as to the best practice. Continued instruc-
tion and training is necessary in order that the greatest
possible amount of B.t.u. be extracted from each gallon
of oil and put to work in the hauling of the train. It is a
well-known fact that a cut-off as short as good operating
results permit saves fuel.

The fireman should be at the firing valve when the lo-
comotive is started, increasing the fire immediately when
the throttle is actually opened and reducing it likewise
immediately when the throttle is closed. The flow of oil
should be gradually increased as required to avoid black
smoke. The fireman should anticipate every change in
the position of the throttle or reverse lever while running
and regulate the fire accordingly. When switching or on
the road, the fire should at all times be regulated to suit
the work the locomotive is performing. When the driv-
ing wheels slip the firing valve should be opened suffi-
ciently to guard against the fire being extinguished by the
excessive draft. When the exhaust is increased suffi-
ciently, the blower valve should be closed and the firing
apparatus readjusted to suit conditions. As a strong
draft in the exhaust may snuff out a low fire, the stronger
the draft the greater must be the oil supply. Care must
be exercised against the sudden opening of the firing
valve, as excessive flow of oil may cause gas explosions
and black smoke.

Carbon formations in the firebox are evidence of im-
perfect combustion and extravagant use of fuel. A white
incandescent color at the peep hole in the firing door and
a slight haze of smoke at the stack reflect the most desir-
able firing conditions. The firing valve, not the injector
or feedwater pump, should be used to control the steam
pressure. Steam pressure should be maintained as con-
stant as possible and near to the maximum working pres-
sure without permitting the safety valves to open. When
oil-burning locomotives are standing or drifting, a light
fire should be maintained in order to have as nearly as
possible uniform firebox temperatures to prevent injury
to the firebox and flues.

Finally, the greatest economy should be practiced at
all times in the use of fuel, exercising good judgment and
harmonious co-operation with the engineman, showing a
willingness to learn and practice the best methods.

The committee consists of Frank Kurz (chairman), fuel engineer, S. P.; T. J. Higgins, road foreman of engines, T. & P.; C. I. Evans, chief fuel supervisor, M-K-T; R. N. McKitterick, fuel supervisor, A. T. & S. F.; H. L. Malette, road foreman equipment, St. L.-S. F.; and R. N. Booker, district road foreman engines, S. P.

W. D. Quarles, Chairman

Managing the Diesel Locomotive

The report is devoted to a study of the fuel system, the lubricating-oil system and the cooling-water system

Even in normal times the problem of dirty fuel is always present due to lack of facilities and care in handling the fuel supply. Clean fuel means more efficient operation, less maintenance to equipment such as fuel pumps and injectors. In a previous discussion you were very ably informed of the ruggedness of the injector and that the clearance between the plunger and bushing was highly machined and to the millionth of an inch. The fuel pump works on the principle of internal gear and drop-off in capacity is generally caused by slight abrasive action of foreign material in oil resulting in end play of the rotor.

The requirements of good clean fuel oil now bring us to our fundamental fuel diagram shown in Fig. 1.

The Fuel System

Each unit comprising the locomotive has its own fuel tank having a capacity of 1,200 gal. At the bottom of the tank are two sumps, the tank sump and the supply sump connected by the emergency fuel cut-off valve. The suction line to the engine enters the supply sump and can only draw fuel if the cut-off valve is open. The emergency fuel cut-off valve is a federal requirement and has to be operative from inside the unit as well as from both sides near the filling plug. It is a spring-loaded valve to be used in case of fire to stop the engine when it cannot be stopped in the usual manner. Each fuel tank has two vents, one on each side with 4-in. flame arrestors terminating outside of the locomotive. This arrestor voids any possibility of a fuel-tank explosion.

Before oil enters the supply pump it passes through the suction filter. Until recently these were three-thousandths spaced wire-wound drums. The handle which operates the drum scraper should be turned every hour while the engine is running. The latest filters, however, are waste packed and should be changed regularly. The elements are repacked with eight ounces of wastex.

The fuel pump is either single or dual. The pumping principle is known as the internal gear principle. An electric motor furnishes the power applied to the rotor which is transmitted to the idler gear with which it meshes. The space between the outside diameter of the idler and the inside diameter of the rotor is sealed by a crescent shaped projection fastened to the cover. As the teeth come out of mesh, there is an increase in volume which creates a partial vacuum. The fuel enters the pump to fill this vacuum and stays in the space between the teeth of both the idler and rotor. When the teeth mesh the fuel is forced from this space and out of the pump. The capacity when pumping against 35 lb. pressure is two gallons per minute. However, it is capable of pumping against a pressure of 150 lb.

The Ful Flo filter is connected between the fuel pump and the sintered-bronze filter. Inside the filter are three

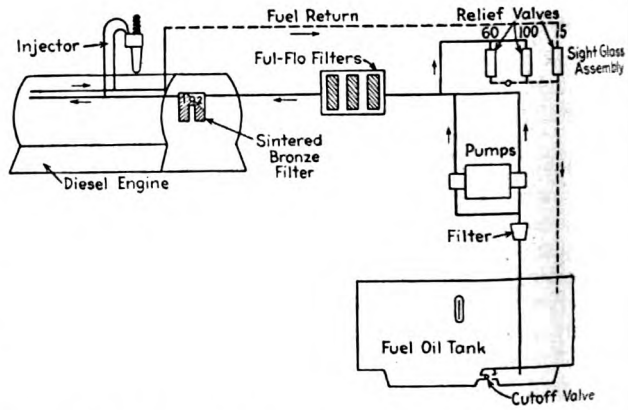


Fig. 1—Fundamental fuel system of a Diesel-electric locomotive

elements made of closely wound string. When the 60-lb. sight glass shows fuel by-passing, turn the handle on the duplex filter to determine whether it is the duplex or the Ful Flo which needs cleaning. If the Ful Flo filter is dirty, all three elements should be replaced and the drain plug at the bottom removed to drain any water accumulation. After reassembling the filter, be sure to vent all air from the chamber through the vent valve on top.

The duplex sintered-bronze filter is mounted on the accessory end of the engine and has a handle which can be swung in three positions. With the handle to the left, the left-hand element is cut off. With the handle to the right, the right-hand element is inoperative. With the handle straight down, both elements are filtering. The handle should, however, either be to the right or left with only one element filtering. The cleaning frequency can best be determined by inspection until a definite schedule can be established. From the duplex

ronze filters the fuel goes to the supply header or manifold running to all cylinder heads in both banks of the engine. Just as the fuel enters the injector, it is filtered for the fourth time by small thimble-like sintered-bronze filters. The purpose of all filtration is solely to protect the injector. Every precaution must be taken to protect this finely machined, yet rugged, equipment from getting any dirt inside.

A surplus of fuel passes through the injector above that needed for proper power output. This surplus of fuel returns to the main fuel-oil tank through the cross-flow lines and 5-lb. sight glass of the relief-valve assembly after cooling and lubricating the precision-made parts of the injector.

In the sight glass and relief-valve assembly the left-hand relief valve is set for 60 lb., the center for 100, and the right-hand for 5 lb. The adjustment must not be changed unless it is definitely wrong and then only by a competent maintenance man. The right-hand glass and valve passes the return fuel from the engine. A drop in the fuel level or an empty glass will indicate that the engine is not receiving its full amount of fuel. Air or gas will show up in this glass as bubbles.

The left-hand or 60-lb. glass will show fuel passing if either of the filters on the pressure side of the fuel pump collected enough dirt to build up a pressure of 60 lb., thus causing the fuel to by-pass the filters and engine and return to the tank. Under such circumstances close the globe valve between the relief valve and return line, again forcing the fuel through the dirty filters at a higher pressure. This will allow the engine to be operated until the maintenance point is reached and the filters changed or cleaned. If the cleaning of the filters is neglected and the back pressure increases to 100 lb., the fuel flows through the center glass and back to the tank by-passing the engine and resulting in loss of power as nothing else can be done except clean the dirty filters.

On each side of the unit is located a direct-reading sight-level gauge 4½ in. from the top. This gauge serves the purpose of checking its fuel level when refueling. The remote type aboard the unit serves the purpose of checking the actual gallonage remaining in the tank. This gauge is actuated by air at reduced pressure, forcing the fuel out of the tank pipe and exactly balances the weight of liquid in the tank. The indicator measures the air pressure necessary to balance the weight of the liquid in the tank and is calibrated to read the amount in gallons.

Trouble Shooting

The following are defects which can and might exist in the fuel system to interfere with proper operation of the Diesel engine.

If the fuel-pump motor is running but the pump is not delivering fuel to the 5-lb. sight glasses, check:

1—Supply of fuel in fuel tank.
2—Emergency fuel cut-off valve closed.
3—Broken fuel-pump shaft or loose coupling.
4—Leaking supply line.
5—Dirt lodged under relief valve.
6—Defective pump, pump seals or scores on either pump or housing.
7—Check suction filter gasket for leaking.

If electric motor is not running, investigate the following:

1—Are the fuel-pump switches on and in good condition?
2—Are fuses good?
3—Check the main battery switch.
4—Check the electrical connections at the motor.

Helpful Hints

1—The fuel-pump motor will labor when the filters in the delivery line are stopped up.

2—The fuel-pump motor will be unloaded with loss of fuel when, (a) emergency fuel cut-off valve is closed; (b) there is no fuel in the tank; (c) there is a leak in the suction line; (d) with loss of prime in the fuel pump.

3—A leak in the fuel delivery line will be noticeable by the loss of fuel, and if a leak exists between the fuel manifold and injector connection lube oil will be diluted with fuel oil. With the engine shut down, operate the fuel pump to find the leak in the fuel line.

4—If bubbles exist in 5-lb. sight glass with the fuel pump operating and the engine shut down, check for an air leak in the suction line. If they occur with the engine operating at maximum power, it indicates that the injector valve is allowing gases to pass into cross-flow fuel line. The defective injector check valve can be located by feeling the return line near the injector. If the line is hotter than normal, bar the engine over until the piston of that cylinder is below the scavenger ports. Operate the fuel pump with the injector rack disconnected and in full fuel position. Then inspect the crown of the piston through the liner ports for fuel accumulation.

5—Improper fuel supply to the injector will be indicated by loss of power. Check serve-motor piston at the governor and load regulator for correct loading.

Lubricating Oil System

The subject of lubrication is probably the most vital of all the details of a Diesel engine. The incorrect methods employed in handling good oils have been responsible for much of the trouble experienced in the operation. The Diesel engine, because of its extremely high operating temperature and precision machined parts, requires a good grade of lubricating oil. The system of lubrication of all Diesel engines fundamentally is the same and the fact that Diesel-engine crankshafts have been in service on locomotives making more than a million road miles with only .001 wear in crank bearings confirms the opinion as to the ability of the oil and the efficiency of the lubricating systems. It is true crankshafts, liners, pistons and other parts have been damaged by scoring, but there was always a definite cause and the major portion of such failures, if analyzed correctly, would be assigned to improver maintenance or operation, such as:

1—Failure to clean and flush the engine and lube-oil system properly after dilution (either water or fuel) or after the replacement of scored liners, pistons, bearings, or other internal damage.
2—Operating with too low oil pressure.
3—Water leaks from cooling system washing lubricant from piston assembly resulting, in some instances, in piston seizures.
4—Not cleaning engine-lube-oil system at stated intervals in accordance with manufacturer's recommendation.
5—Failure to handle oil in clean containers.
6—Operating engine with either high or low water-jacket temperature, high temperature causing oxidation (sludging) of oil and low temperature causing water, a product of combustion, to wash the lubricant from contact surfaces, resulting in wear at three times the normal rate.
7—The use of reclaimed oil other than in proportions covered in instructions.

Figure 2 is a fundamental drawing of the lubricating oil system of the EMD 567-A engine. The oil system consists of three parts: (1) the main-bearing pump, oil switch and relief valve; (2) the piston-cooling oil pump and "P" pipes; (3) the scavenger oil pump, strainers and oil separator.

The oil pan of the engine is large enough to hold the main portion of the lubricating oil of the oil system, classifying the engine as "wet sump." A bayonet type oil gauge is used to take oil-level readings which are as follows: System uncharged, system charged, high and low level. These readings can be taken with engine running or stopped. The capacity of the sump is 180 gal. To fill, pour this amount of oil into the filter basket

strainer. From here it will fill the oil-strainer chamber through the pilot hole. It will also flow into the engine oil pan. As a check on the amount of the oil entering the system, the oil level should be at the "uncharged level" on the bayonet gauge when 180 gal. have been added, after the system has been drained.

The Lubricating Oil Pumps

The two lubricating-oil pumps (piston-cooling and main-bearing) are combined in one unit mounted on the accessory end or pump end of the engine, with one suction line connected to the lubricating oil supply. The pumps are of the positive-displacement type and the pump rotors are helical spur gears. The piston-cooling portion of this pump has a capacity of 53 gal. per min. at 800 r.p.m. and delivers oil through the manifold to the bottom of each cylinder liner where a nozzle directs a stream of oil into each piston. The main-bearing pump has a capacity of 107 gal. per min. and delivers oil to the pressure lubricating system. When the engine is started, the pressure pump will pick up the oil from the bottom of the strainer chamber. This oil will provide an initial charge for lubricating the engine until the scavenger pump has refilled the strainer chamber. The scavenger pump has a capacity of 214 gal. per min. at maximum speed and is of the same type as the others. It is mounted on the lower part of the accessory-drive housing, draws oil through its oil screen and forces it through the Michiana filter and cooler back to the tank. A constant oil level is provided in the oil cooler on the cooler side of the oil dam. Oil flowing over this dam returns to the engine oil pan. This keeps the scavenger-pump suction pipe under oil and provides a "wet sump." The oil reading on the bayonet gauge should now be between the high and low level.

A spring-loaded relief valve is connected to the passage in the accessory drive housing through which the lubricating oil flows to the main bearing manifold. The spring pressure is adjusted by a regulating screw so that the lubricating oil enters the main manifold passage at the required pressure. However, the oil-pressure relief valve cannot be adjusted while the engine is running. It is normally set at 45 lb. An accurate check of its setting can be made by attaching a pressure gauge on the oil manifold on the opposite side of the engine. The main-bearing pressure gauge is connected to the oil line at the blower end (rear end) of the engine. Therefore, with the engine warmed up and operating at 800 r.p.m., this gauge should register only 30 lb. as there is a 15-lb. drop through the engine.

Protection Against Low Oil Pressure

The oil system is protected by a low-oil-pressure switch which consists of a spring-loaded diaphragm actuating a pair of electrical contacts. This low-oil switch should operate at 6 to 9 lb.; that is, it should pick up at 9 lb. and drop out at 6 lb. If this switch operates, it de-energizes the E master magnet valve and drops the engine speed to idle position. Under such circumstances the engine should not be run until the trouble is located and corrected. *The engine must not be run without low-oil protection.* To test this switch with the engine shut down, place the isolation switch on the engine instrument panel in run position. If the low-oil light comes on and the gong sounds, the switch is operating correctly.

If the main-bearing oil pressure drops below 20 lb. (at 800 r.p.m. hot oil), stop the engine and investigate. Look for stopped-up suction strainer in the tank, a stuck relief valve, broken oil lines, low oil viscosity, worn oil pump, loss of prime in pump, suction lines leaking and destroying the vacuum, or low oil.

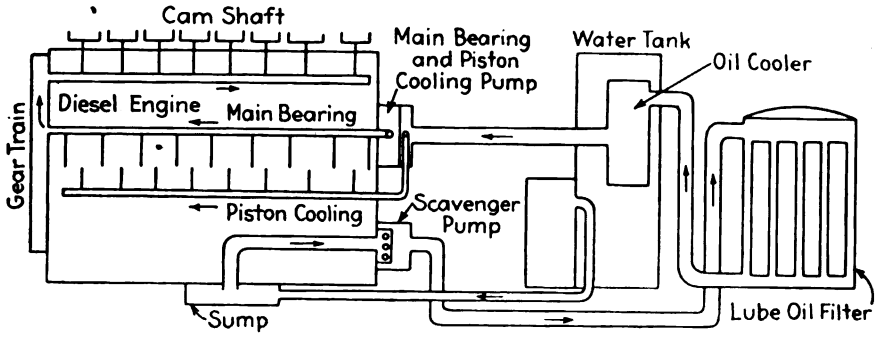


Fig. 2—Fundamental lubricating oil system for Diesel-electric freight locomotives

The piston cooling system has no relief valve or low-oil-pressure switch, so pressure is dependent upon oil temperature, viscosity and engine speed. Usually the pressure will 20-30 lb. at 800 r.p.m. and 4-8 lb. at idling speed with a warm engine. If pressure drops below 15 lb. (at 800 r.p.m. hot oil), stop the engine and investigate possible causes.

The oil separator is a unit mounted over the main generator. Air is drawn through this from the crankcase to the air-box blower intake. It is provided with a metal screen which condenses any oil from vapor which is taken from the crankcase. The condensed oil then returns to the oil pan or sump.

The lube-oil cooler is nothing more than a radiator located in the water tank. Its location there is in order that the oil temperature will be reduced to nearly that of the jacket water which is about 165 deg. Therefore, if the water-jacket temperature is properly controlled and the oil coolers are clean and functioning as they should, there should be no breakdown of the oil causing sludge formation or other oxidation products which are so detrimental to the Diesel-engine operation.

Keeping the System in Operation

Next to the selection of the proper oil is correct filtration and changing of oil at the schedule mileage recommended by the manufacturer. The condition of the lube oil between change-outs can be determined by analysis. The viscosity generally increases with service unless there is a dilution and it should be checked at maintenance point with Visgage each trip to determine its condition for further service. Periodically, oil samples must be taken and sent to the chemist for laboratory test for corrosive acid, and determination of flash, fire and precipitation number. The lubrication-oil suction strainers located in the tank should be cleaned each trip as the present Wastex used in the Michiana filter contains more lint than it normally did. This lint adheres to the

ainers. The Michiana oil filter contains four elements. l flows from around the outside of each element into perforated tube at the center. In the base of the filter using is a relief valve which is set to operate at 16 to lb. The filter elements are made of Wastex which packed tightly into perforated containers. These filters ar the oil of sludge and dirt but cannot remove any el oil or water which may be mixed with the lubricating . In servicing these parts, the presence of a black tarry bstance collected on the lube-oil-tank suction screens a badly purged Michiana filter pack indicates a water ution of the lube oil and the engine must be held from rvice until the trouble is found and corrected.

If the lube oil begins to assume a dark or dirty color d it is otherwise correct, check to see if the Michiana ter elements are in place over the tubes at the bottom the tank. If found to be in place, the color of the oil en indicates that filter elements should be changed at orter mileage intervals.

Excessive oil consumption may be caused by a leak, oken or stuck rings, worn piston, excessive oil pres-re, clogged oil drain hole in the piston or air-box blower als leaking. The most of such defects will manifest emselves by excessive oil in the air-box drain tanks.

Little or no oil consumption may be due to water or el leaking into the oil.

Excessive wear in engine moving parts requiring lubri-tion will probably be due to the absence of lubrication hen starting up. Water condensed on cylinder walls ie to improper combustion or water leaking from cool-g system by the head gasket or the seal and contamina-on of the oil due to ineffectual air or oil cleaners.

Cooling—Water System

The cooling systems of the various engines in the comotive are independent of each other. They are milar to each other in every respect except that the first ction (A units) have heater to heat the control room. Vater is drawn from the water tank by centrifugal pumps cated on the accessory end of the engine. The pump npellers are of the single-suction type and operate at 440 r.p.m. with engine speed of 800 r.p.m. and the ombined capacity of the two pumps is 214 gal. per nin. at that speed. These pumps draw the water from he tank which has a capacity of 245 gal. and circulate it hrough two tubular passages, one in each bank of the rankcase, which connects to the water spaces between he lower deck plates. From this section the cooling vater enters the lower end of the cylinder-liner jacket and flows through the liner and through the cylinder head and from there it discharges into a water space along the upper section of each bank of the engine. The water is then discharged from this chamber into the water-outlet elbow connections to the four radiator sections located in the roof as shown in fundamental drawing Fig. 3.

The four cooling fans in the roof are driven from two speed increasers, one located at each end of the engine. The temperature of the water is controlled by the fans drawing cool air from the outside through the shutters. Closing the shutters restricts the air flow through the radiators and allows the water to heat up. Opening the shutters gives more air flow and causes the water to get cooler. The speed increasers are driven from the main shaft by friction clutches. These clutches are not to be engaged at above idling speed; to do so will seriously damage the driving mechanism. In cold weather, when difficult to control the engine temperature, it may be necessary to operate with one clutch disengaged. If this is done, it should be on the accessory end. On the generator end the fan circulates air through the high-voltage cabinet. After the water is cooled in the radiators, it flows down and through the oil cooler then into the water tank for reuse, thus completing the cycle.

Located on the water tank there is a water-level gauge. This should be full when operating. The engine should not be operated below the mark indicated on the gauge.

If the engine consumes water and there is no evidence of leaks in the cooling system it may be that a cylinder lower seal (either rubber or steel) is leaking or a head-to-liner gasket is leaking. In either event, the water will be going out with the exhaust in the form of vapor when the engine is running. Such leaks may be located by removing the cylinder test-valve packing with the engine working. Water will leak to the outside of the engine and be visible at the cylinder test valve.

Use Pure Water

Distilled water or rain water should be used in the cooling system to eliminate the accumulation of scale which contributes to engines overheating. Each cooling system is filled either through the filler pipe located on the roof above the water tank or through the filler alongside the fuel tank. The engine-water thermometer is located in the water tank and the temperature should be controlled at 165 deg. F. + or — 15 deg. An even temperature of 165 deg. F. is most desirable as combustion of the fuel is more complete, preventing moisture

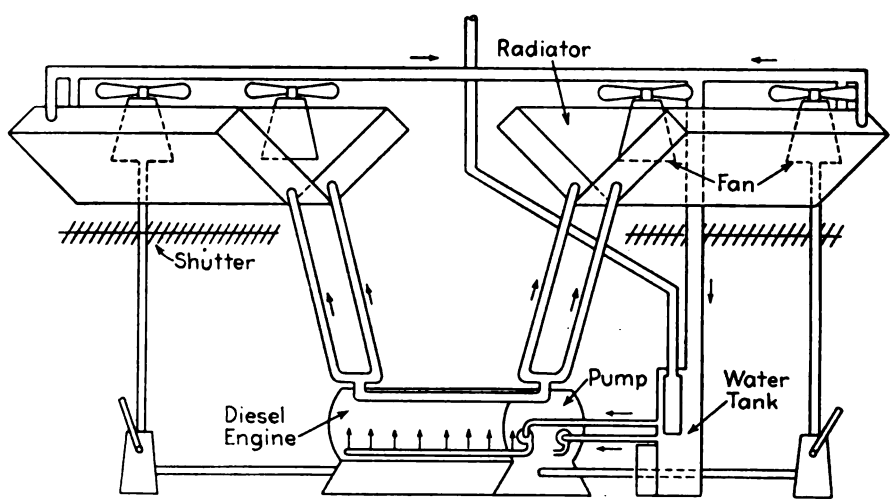


Fig. 3—Fundamental cooling system for Diesel-electric freight locomotives

and relieving the engine of the strain of expansion and contraction. Such strains contributed to cracked heads and liners and moisture washes away lubrication. Lack of lubrication will result in scoring and possible seizure of the piston in the liner. The cooling-system temperature can best be maintained with automatic shutter control. The gauge in the water delivery line should register 4 lb. at idling speed and 16 lb. at 800 r.p.m. with a clean cooling system. Greater pressure indicates obstruction. In checking for restriction in water circulation, the radiator header should be examined as the inner lining of the cooling system hose sluffs off and invariably lodges at that point. If the system is obstructed with scale it will be necessary to clean the entire cooling system as follows:

With the engine at approximately 400 r.p.m. and temperature 140 deg. F. to 180 deg. F., circulate a solution of Oakite penetrant in the proportion of three ounces per gallon of water for at least 30 min. to remove oil or grease. Drain this from the system and flush with clean water. Then with the engine idling and the temperature at approximately 140 deg. F., circulate a solution of 10 per cent Oakite No. 32 for not more than 30 min. Now drain the system, flush it once with clean water, circulate a solution of Oakite penetrant in the same proportion as before to neutralize the acidity. Fill the system with regular radiator water and test for acidity. If the test indicates no acid, then add one pe cent of radiator compound R-3-7 to prevent erosion The cooling system must be maintained free of wate leaks as the use of hard untreated water will not onl cause scale formation but the area exposed to high tem perature will be subject to severe pitting. If the syste is properly maintained it will be necessary to add wate only at the maintenance point, where properly treate radiator water is provided.

An engine temperature switch is located by the engin instrument panel and connects to two thermal element one in each water outlet manifold of the engine. I the water temperature exceeds 200 deg. F. this switc closes, operating the signal relay which lights the hot engine alarm light (red) and rings the alarm bell.

Never add cold water to a hot engine. If hot water i not available, crack the steam valve to the cooling syste while water is added in small volume.

The cooling system is not protected with anti-freez solution. If the system needs protection in winte weather and steam is available, open the two heate valves to the cooling system, also open the steam, th steam valve to toilet water tank, and steam generatin equipment on B section. If steam is not available, the drain each of the systems to prevent freezing.

W. D. Quarles, Diesel master mechanic, A. C. L., i chairman of the committee.

Road Foremen Belong in the Cab

By Theo. Olson
Superintendent Motive Power, Chicago Great Western

Maintenance of close contact with work of road crews is needed—Best locomotive performance results when road foreman has time to teach men

The work performed by engine crews is such that it is important that each particular duty be performed in an exacting and proper manner. Any inefficient or neglectful work by engine crews will in one way or another cause not only unsatisfactory locomotive performance, but also additional expense. It would be difficult to evaluate exactly the effort and expense that may be warranted in training engine-service employees to reach a high degree of efficiency.

Irrespective of what system may have been adopted for the education of engine crews, undoubtedly it is recognized that most of the training or education in their particular field of work has been through more-experienced employees imparting their knowledge to their new and less-experienced associates. With the system in vogue on American railroads, all locomotive enginemen have worked for several years as firemen before being promoted to engineman. The time served as a fireman before being promoted to engineman may properly be termed a period of apprenticeship for the position of engineman. Enginemen are fully familiar with the duties of a fireman and consequently are qualified to instruct and train the firemen in their work.

It is evident that the type of practical training afforded new employees entering the service will depend largely on the qualifications and thoroughness in their work of the men operating the locomotives. An efficient and capable engineman will not tolerate careless and inefficient work on the part of the fireman. Such an attitude affords training that would be difficult to obtain in any other manner, provided the inexperienced employee is interested and anxious to learn.

Firemen Learn from Enginemen

The engineman's part in educating firemen in the proper performance of their duties is more effective when engine crews are regularly assigned and work together for a period of time. When an engineman has a different fireman on almost every trip the opportunities, as well as inclination, for training the fireman are limited. The system of having a regularly assigned fireman with an engineman is not nearly as common now as it has been

the past due to changed working conditions, etc. Inmuch as the present-day method of operation has minized the opportunity for enginemen to educate the fire:n, it is necessary that additional means be provided.

The training of enginemen in their work of handling :omotives, proper use of air brakes, supervision of fire:n in proper performance of their duties, etc., and the ining of firemen to obtain needed knowledge for pro)tion to engineman can be obtained only partially in :lassroom or through the study of text books. There:e, instructions must be imparted to enginemen and emen while on the job by competent men who not only ve a complete technical knowledge of the various phases locomotive operation, but who are also able to demstrate by actual performance the handling of loco)tives as well as the art of firing. The necessity for ch instruction and supervision has long been recog:ed and led to the appointment of road foremen of gines. These positions do not in all cases carry the ne title, nor are their duties identical.

On railroad systems which do not have traveling fire:n or supervisors performing similar duties, the road reman of engines must ordinarily cover the entire field supervising and instructing engine crews regarding e proper handling of locomotives and air brakes, the onomical use of fuel through skillful handling of a :omotive and proper firing, and other duties pertaining the work of engine crews. The road foreman, there-re, must be fully qualified himself in all phases of :omotive operation, including train handling and proper ing practices, in addition to having a thorough knowlge of locomotive construction, air brakes, and all apiances in use. Road foremen possessing these qualifitions will be able to analyze and determine the causes inferior performance, whether it be due to a condition the locomotive or the crew operating it.

A Road Foreman's Duties

Inasmuch as the road foreman generally is the officer ld responsible for the performance of engine crews in e handling and firing of locomotives and, perhaps, is e only officer assigned to instruct engine crews regardg their work, it would appear that the duties of the ad foreman of engines, when no other supervisors are signed in the field, should be principally as follows:

1—Riding with inexperienced enginemen and new fire:n frequently and instructing them in the proper perrmance of their duties.

2—When there are no new or inexperienced men in the rvice, spend most of the time riding with and instructing e enginemen and firemen whose work is not up to erage.

3—Analyze and make a prompt investigation of all igine delays and failures and discuss the reasons and e means for preventing recurrences with all enginemen. making such investigations, it is frequently necessary follow the engine to a repair point to make sure that ithentic information is received. By discussing delays at have actually occurred and the proper methods of king care of breakdowns, an impression will be left ith the enginemen that will be remembered readily and able them to handle similar situations in the future.

4—Keep familiar with methods of drafting locomo:es and watch this phase of locomotive operation closely. remendous fuel waste occurs by improper drafting of comotives. On the other hand, very satisfactory fuel :vings can be made with free-steaming engines which :e drafted properly, and which have stokers and grates good condition, flues kept clean and free from leaks, ont ends free from air leaks, etc. The maintenance forces at enginehouses have no definite means of knowing the road performance of locomotives except from reports received from road foreman or engine crews. In some cases reports from engine crews are not considered entirely authentic, and it is necessary for the road foreman to ride locomotives frequently enough, and check reports submitted by engine crews, to know whether or not there is any condition that needs correction in order to maintain maximum efficiency with reference to the steaming and fuel economy of his locomotives.

5—Hold meetings monthly at each important terminal to discuss current problems with enginemen. Meetings should stress the importance of fuel economy and the elimination of unnecessary black smoke which indicates fuel waste. Cases of fine performance by some men should be pointed out as an inducement for others to try to attain similar good performance. Make an effort to provide sufficient instruction literature to enable enginemen to keep fully posted on advancements made in the motive-power field and on air brakes.

6—While riding locomotives, make a thorough inspection of the locomotive and report any existing defects. Also, in the course of inspecting locomotives instruct enginemen and firemen how and where to look for defects and how to make a proper report of them. Keep a record of the condition of locomotives so as to be in a position to assist the mechanical-department officers in determining shopping schedules.

7—Keep a close and detailed check of the manner in which the engine crews perform their duties and how carefully the enginemen are watching important matters such as the maintenance of a proper water level in the boiler, the checking of boiler-feeding appurtenances, proper lubrication, proper functioning of air brakes and other matters essential to safe operation. Note what attention is provided the locomotive en route to prevent delays that can be eliminated, such as early attention to worn bearings, and delays in cleaning fires. By studying the work of the engine crews road foremen will soon be in a position to know where supervision is most needed. Careful observations should also be made as to compliance with existing operating rules and, if violations are noted, prompt and corrective measures taken.

Don't Overlook Road Foremen

There may be a number of other duties that road foremen are expected to perform. Nevertheless, if the territory to which a road foreman is assigned and the number of employees to supervise is sufficient to occupy his time in carrying out the duties mentioned, further duties should not be imposed on him. His time should be spent primarily in riding locomotives and supervising the men at their work. It cannot be expected that full knowledge can be obtained of the qualifications of the men or the performance of the locomotives merely by meeting engine crews at terminal points for a brief interview or a casual inspection of the locomotives. Neither are best results obtained by merely holding a post mortem after irregularities have occurred, whether it be regarding an engine failure, drawbars pulled, poor train handling, or failure to make schedule time. While investigation of such irregularities is essential, it is certainly preferable to make every possible effort to educate the enginemen to the extent that avoidable irregularities are eliminated. To accomplish this, a road foreman must spend his time with and among the men on the road.

The road foreman's work is such that it requires capable men interested in their work and willing to devote their full time and attention to their duties. However, it is an interesting field of activity and pays ample returns on properly directed efforts.

How To Get Rid of Black Smoke

What one road did to its locomotives and the results achieved — Over-fire steam-air jets an important factor

G. B. Curtis,
Chairman

Black smoke emitted from the stacks of locomotives indicates either carelessness on the part of one or both members of the crew, improper design of locomotive grates, ashpan, draft arrangements, or the improper maintenance of the locomotive.

It is a well-known fact that black smoke is combustible and is a waste of a very important commodity necessary to the promotion of transportation and the living conditions of the American people. We all know that it requires the proper amount of air heated to the proper temperature, with a supply of fuel, to produce combustion and when too little or too much air is supplied to the combustion area and temperatures are not brought up to the proper point a part of the fuel, volatile carbon, will be emitted from the combustion area as black smoke. Even after applying to the locomotive all of the modern devices known to aid combustion, we still have the human element with which to deal in the elimination of black smoke and, if the engineman and fireman do not cooperate and use good judgment, we will still have excessive smoke from our locomotives.

One Road's Experience

Until about fifteen years ago our locomotives were equipped with the Master Mechanic's front end and with a ½-in. nozzle for each inch of cylinder. They were also equipped at that time with extension stacks running to 18 in. or 20 in. above the nozzle tip, which was the Goodfellow type. Most of our locomotives were then running with an open arch—that is, we were using toe brick between the arch and the throat sheet.

After extensive experiments, we increased the size of the nozzle on the engine with 26-in. cylinders to 8 in.. using a cross-bridge on the nozzle, or what is commonly known as the spreader type nozzle. We lowered the extension stack to within 14 in. of the nozzle tip and took the toe brick out of the arch, making what we refer to as a sealed arch. This greatly improved the conditions in the combustion area of the firebox of the locomotive and reduced the amount of smoke to a minimum while the engine was working steam.

We still had difficulty in keeping down smoke while the engine was standing at terminal or on the fire tracks due, in my opinion, to not getting enough air through the fire bed into the combustion area. This, of course, brought up the idea of inducing over-fire air into the combustion area and, at the invitation of a neighboring railroad, which had made an extensive study of over-fire air induction tubes, I rode an engine of this railroad and, with the co-operation of the mechanical department of our own railroad, we equipped a Mallet type engine, which was used in hump service in the yard, with the over-fire air-jet induction tubes. These locomotives a of the 2-8-8-2 wheel arrangement and have a 17-ft. fir box with the Gaines fire wall set back 3 ft. from th throat sheet. They were not equipped with an arch an were fired with duplex stokers.

It was almost impossible to fire these engines in hum service without making objectionable smoke and we, lik all other railroads, had to use any one we could emplo as firemen. Five of the airjet tubes were installed on eac side of the firebox, these tubes being equipped with silencer which cut down to some extent the noise fro the steam jets while they were working. The operatio of the jets was interlocked with the operation of the en gine blower with a cut-off valve at the turret. Test were made after this locomotive was equipped with th steam jets without an arch and pictures were taken b smoke abatement engineers of the District of Columbia One picture was taken after the engine was fired u which showed a No. 5 smoke. The steam jets wer then put in operation and another picture was taken les than thirty seconds after the jets were put in operatio and showed practically a clear stack.

We found, however, that some of the men who ha been enginemen so long that they had become set in thei ways objected to the noise of the steam jets and, whil the noise was not any more than the stoker would mak they insisted on the fireman shutting these jets off whe there was no supervisory force around.

To overcome this trouble with crews failing to operat these jets at all times when the locomotives were bein fired, the operation was interlocked with the stoker an the blower and the extension handle taken off the suppl pipe at the steam turret.

A fireman with a few days' experience and a little car can operate the stoker continuously for several minutes or as long as is necessary to maintain full steam pressur and not make more than a No. 1 smoke.

We have now equipped these engines with brick arche and they can be fired with absolutely clear stacks.

After meeting with successful performances of th steam air jet on this type of engine, we had ten new pas senger engines, which were being built for us by th Baldwin Locomotive Works, equipped with the blower hooked up with the steam jets and have an arrangemen whereby the jets may be used from the house blower this being of material benefit in firing engines up in th house. We are also equipping our other locomotives i this manner as fast as they go through the back shop. Al of our road engines are equipped with sealed arches an the new draft appliances referred to above.

Our instructions to firemen are to use the scoop in pre paring locomotives for the run, using the blower lightly which, of course, brings the over-fire jets into service.

Skilled Firing Still Needed

For road operation smoke abatement and maintaining a hot engine with the least quantity of fuel is largely a

ter of timing by the firemen. Over-feeding of the is often the result of the fireman's failure to note the nges in the cut-off made by the engineman, increasing decreasing the demand on the boiler. His failure to ease or decrease the amount of coal required to main- full steam pressure results in smoke emissions. n some cases where safety valves are allowed to raise to the fireman not exercising the proper judgment in ding the right amount of coal to the fire, he will shut stoker off a few seconds too long, which will allow firebox temperature to be reduced to where smoke uld be made while attempting to gain the lost steam ssure. Any change in the demand for steam output the boiler should be noted promptly by the fireman in order that he may change the amount of coal to be fed to the fire and maintain a uniform steam pressure.

In case of yard firing, engines equipped with over-fire air-jet tubes can be fired with a No. 1 or less smoke by the use of the horseshoe bank—that is, firing heavily around the sides and back sheet, having the fire light in the center of the firebox where the temperature is the highest.

Supervisory forces should start giving instructions on smokeless firing to a new fireman the day he starts his student period as a fireman and they should be impressed upon him at every opportunity.

The chairman of the committee is G. B. Curtis, road foreman engines, R. F. & P.

Getting More Service from Locomotives

A. A. Raymond, Chairman

Time at terminals and enginehouses must be reduced—Many facilities needed—Scheduled maintenance for steam power pays dividends

ggestions have been solicited from leading men on the rious railroads as to what, in their opinions, will aid in taining maximum utilization of locomotives. Their ggestions are summarized in the report of the Committe on Utilization of Locomotives and include the follow- g: use of all locomotives in pool service; extension of gine runs; the use of combination-type, freight-and- assenger locomotives; and the purchase of locomotives the latest design specifications which are roller-bearing quipped, are built of high grade materials throughout, nd have cast-steel beds, stokers, and lubrication systems adequate capacity with lubrication from forced-feed ibricators to all parts requiring it. These locomotives hould all have large-capacity tenders and ashpans. roper water treatment is regarded as essential in obtain- g the utmost in service from all locomotives.

Another feature to be dealt with is the spacing and cation of water, fuel, sand and ash-dumping facilities. t is suggested that these facilities should be built so that ll servicing can be done at one point in a minimum length f time. This requires high rates of delivery for fuel and vater—40 tons of coal and 5,000 gal. of water per minute eing suggested as the lowest figures which should be onsidered.

Cutting Terminal Time

A number of things were suggested which would have n appreciable effect in cutting down locomotive terminal ime. Locomotives should be inspected immediately upon heir arrival. Auto-gas station type lubrication requires locomotives with complete installations of Alemite-type fittings. Hot washing and filling systems are needed for boilers. There must be adequate equipment for dropping wheels, all drivers at once if necessary, and complete engine and trailer trucks. Overhead and portable lifting facilities are needed, and wheel-storage tracks with handling equipment of adequate capacity should be located at a convenient, nearby point.

Enginehouse machine shops must be tooled so that needed work can be done quickly. Equipment and facilities must be provided so that necessary work on rod bushings, springs, etc., can be done in the shortest possible time. Proper lighting is essential to the best work and enginehouses and inspection pits should have it. Ash pits should be located so that they are easily cleaned without delaying locomotive movements. In the northern districts it will be necessary to have enough snow-handling equipment to keep the terminal territory clear. Thawing equipment for locomotives, frozen cars of coal and coal pockets is also needed.

Out-of-service terminal time can be reduced by using road freight engines in idle hours for yard switching and by servicing switching locomotives during the crew lunch periods.

Enginehouses often have too many stalls and get to be graveyards; fewer stalls and good enginehouse equipment will keep the engines on the road and working.

Such conditions automatically increase between-shop mileage and lead to higher standards of maintenance. Some locomotives have been reported as running 2,500 miles before being held for special inspection and necessary adjustments. Through runs which have been reported are 482, 771, 1,221, 1,430 and 1,506 miles.

Planned Enginehouse Handling

Here are several examples of good handling:

In the first case, a locomotive arrived which had a driving spring requiring replacement. Three hours later it left with a train; the driving spring had actually been renewed in one hour and thirty minutes.

In another case a locomotive was given a regular monthly inspection and left with a train twelve hours after arrival.

In the third case, an arriving locomotive was in for a quarterly inspection. In addition to washout and other regular attention, it required the renewal of three side-rod bushings and four knuckle-pin bushings. Nineteen hours after the locomotive's arrival it left with a train.

Planned Maintenance Pays Huge Dividends

In a detailed study made between a locomotive receiving routine maintenance attention and use and one where intensive utilization was aimed at under careful daily supervision with planned maintenance procedures, the figures shown in the table were developed:

The Effect of Planned Maintenance Procedure

	A year's general operation		Planned and closely supervised operation	
	Hrs.—Min.	Per cent	Hrs.—Min.	Per cent
Total time	8,760— 0	...	1,379—07	...
Enginehouse time	5,187—35	59.2	366—40	26.6
Time on road	3,572—25	40.8	1,012—27	73.4

The figures indicate that time at enginehouses can be reduced about 50 per cent if all locomotives could be handled in the same manner as the test locomotives were handled; that is, by careful daily supervision of their use and the following out of planned maintenance procedures. The figures for general operation given above, when broken down, showed that the average engine was held at intermediate terminals for work on rods, valves, pistons, crossheads, wheels, boxes, spring rigging and engine-truck equalizers. Using planned maintenance procedures the 50 per cent saving in enginehouse time can be realized because necessary work on locomotives is anticipated by enginehouse forces.

Fundamental Facts About Utilization

The Railway Age of February 5, 1945, effectively summarizes some of the principal points relative to utilization as follows:

1—In comparison with the Diesel-electric for road service, the steam locomotive has at least four handicaps. These are (a) the greater frequency of stops for coal and water; (b) the time required for fire cleaning and ashpan dumping; (c) the smoke and cinder nuisance, and (d) boiler maintenance.

2—The employment of large-capacity tenders and of auxiliary water cars has greatly reduced the handicap of service stops as an interference with the continuity of train movement. The provision of main-line coaling stations and water cranes is also contributing to the reduction of this interference.

3—It has been demonstrated on numerous occasions that fires can be maintained almost indefinitely with some fuels, but as long as coal is burned on grates, the ashpan must be dumped. Dumping can be done when coal and water are taken without adding further delay.

4—The locomotive boiler was the source of the greater portion of the labor and expense of maintaining locomotives until the advent of water treatment, seal welding of tubes in back tube sheets and the welding of inside fire-box sheets which effected a revolution in locomotive maintenance and machinery repairs took the lead. However, improvements in running gear, roller bearings, etc., has reduced machinery maintenance and the boiler has resumed its former lead.

A. A. Raymond, superintendent fuel and locomotive performance, N. Y. C., is chairman of this committee.

Handling Heavy Passenger Trains

Starting the train without shocks—Technique of slowing down and stopping, including use of independent brake and graduated release

Frank C. Goble, Chairman

The subject of passenger-train handling is of special interest to those who make the rules and should be to the ones who are to execute them. It requires a great deal of practice and good judgment to do a job of smooth train handling.

In the first place, the engineman should know that the locomotive, whether steam, Diesel, or electric, in his charge is in a satisfactory condition for service and that the air pressures are correct and that proper tests have been made to assure that the devices are operating as intended.

After coupling to the train and having the brake system charged to at least 70 lb., a 15-lb. reduction should be made and brake-pipe leakage noted and reduced to its minimum but at no time to exceed 7 lb. per min. After the inspection of brakes is completed, the engineman should be notified as to their condition by the inspector or employee making the inspection.

When the signal to start is given, the train must be started slowly. This requires great care. An engine must not be allowed to accelerate too rapidly during the time a train is being started. As each car is moved it is brought from a speed of zero to that corresponding to the engine and this difference must be as slight as possible. Smoothness must not be sacrificed to save time.

Running Test

On a passenger train, on leaving an initial terminal or any other point after the engine or engine crew has been changed or an angle cock closed, except for cutting off cars or engines from the rear, a running test of the brakes must be made as soon as speed permits. Such test should be made by applying the brakes with a total brake-pipe reduction of 15-lb. or more to ascertain whether they are operating properly. The engine brakes should not apply. Steam or power should not be shut off

nless conditions require it. In case the brakes do not perate properly in this test, the signal for brakes must e given.

Stopping—Electric or Diesel Locomotives

When stops with electric or Diesel locomotives are nticipated, power may be shut off or used. If power is hut off before making the initial reduction, ample time iust be allowed for the slack to adjust itself. If the iitial reduction is made before shutting off the power, : may be continued until pressure is indicated on the rake-cylinder gauge; then place brake in lap position. 'o explain this, the engineman will use power approach-ig a station and make a 10 to 15-lb. brake-pipe reduction efore shutting off power, the object being to keep the lack stretched while the brakes are applied; also to ermit a heavier reduction being made while the speed is igh which effects rapid deceleration. Further reduction not to exceed 25 lb.) may be made to reduce speed; hen the brakes graduated off.

Stopping—Steam Trains

On steam engines where power is used to the point of making a service brake application for a stop, its use should be continued until the brakes have been applied and the speed reduced when the throttle should be gradually closed or moved to a drifting-throttle position.

Power Breaking

When necessary to make a slow-down, such as at draw bridges, curves, etc., it should be made while using power, keeping the locomotive brake released. Before passing the point of slow down the train brakes should be fully released and, if necessary, the throttle eased off to a slight pulling throttle so that the speed will not be materially increased over the distance of the slow down or curve. With present day schedules, it is impossible to drift all slow downs at required speeds without loss of time; therefore, power braking is the preferable method. If the locomotive is equipped with a speed indicator, an engineman can comply with all the slow downs at the required speeds. For example, if the speed restriction requires a given speed of say 50 m.p.h. and the speed aproaching that point is 70 m.p.h., the engineman should make a brake application of not less than 15 to 20 lb. and brakes should be released at a speed of 5 to 10 m.p.h. above the permissible speed required for point of slow down.

Graduated Release

When engines are equipped with ETEL or combined automatic and straight air brakes and the graduated release feature is operative on the cars, the brakes should be partially graduated off before stopping, provided the reduction total is 15 lb. or more, until brake-pipe pressure is restored to within 10 to 12 lb. of feed-valve setting. The reason an attempt should not be made to graduate the brakes off after the brake-pipe pressure is built up to 100 lb. is that there is a liability in time to retain pressure in brake cylinder. For the same reason it is not advisable to attempt to make a graduated release if only a 10-lb. brake-pipe reduction has been made.

To effect graduations the brake-valve handle should be manipulated between lap and running or holding positions with the No. 6 ET equipment. With steam locomotives equipped with No. 8 ET equipment it has proved very successful to place the independent brake-valve handle in lap position to retain a pressure of at least 30 lb. in the brake cylinder prior to making graduations of the train brakes. This procedure will permit the closing in of slack on the head portion of the train (say, a car or two). By using this method it is seldom necessary to take the slack when attempting to start a heavy train.

Consideration must be taken as to length of time the brake-valve handle should remain in running or holding position in order to effect graduation on the last car of the train. With trains composed of eleven or more cars, brake-pipe pressure should be increased 5 lb. on the first graduation and approximately 3 lb. for each subsequent graduation.

Two-Application Stop

For a two-application stop the brakes should be applied with an initial brake-pipe reduction of 7 lb. unless power is being used, when the initial reduction may be increased to 10 to 15 lb., followed by further reductions not to exceed a total of 25 lb. If necessary to reduce the train speed to 10 to 15 miles per hour, the brakes should then be released by placing the brake-valve handle in running position for at least 10 sec. (more than seven cars, 15 sec.) before starting the final application. The final application should be made with a brake-pipe reduction of 10 lb. or less.

After the stop is completed, the reduction should be continued until a 15-lb. reduction has been made in order to assure a release of all brakes.

The Independent Brake in Passenger Service

The independent brake may be used to bunch slack, control speed or stop, but when used it should be applied gradually and as lightly as possible.

The ideal stop with the independent brake is accomplished when the engine brake is graduated off and final release occurs just as the train comes to a stop, unless on a descending grade, when a light brake-cylinder pressure should be retained.

Taking Slack

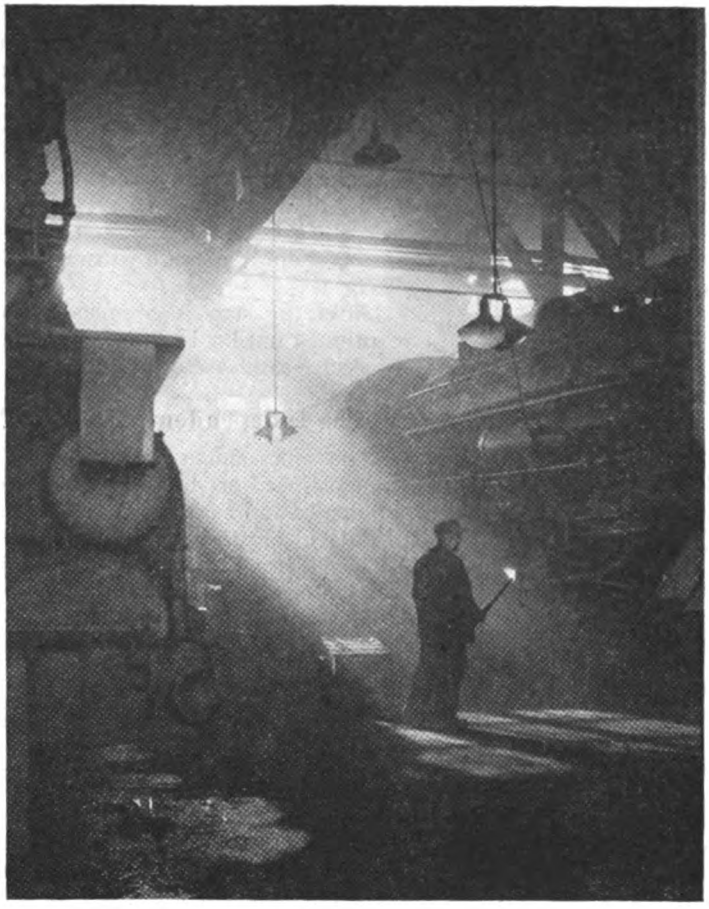
When it is necessary to take the slack to start, take it on only two or three cars. Should this fail to start the train, take the slack off the entire train and, when conditions require, apply the train brakes, holding the engine brake off, using power until the train stops. After stopping, place the reverse lever in forward motion. Make sure the brakes are released and start carefully, stretching the slack slowly until the entire train is in motion.

Training New Enginemen

These instructions cover the handling of passenger trains so that it will be agreeable and comfortable for those who are riding them. Every road has its particular method of handling air-brake equipment and if that method is satisfactory, it is the proper method to use. When rules are made, it is a supervisor's job to see that they are complied with. By giving the men proper instructions and demonstrations we can accomplish this, but we must depend largely on the judgment of the engineman in handling because of the different make-up of trains, etc.

On one of the eastern railroads it has been the practice for the past eight years to have a road foreman of engines or first-class engineman supervise a fireman for his first three trips after he is promoted to the position of engineman or until he is found competent in third-class service. This procedure is followed for both second- and first-class service. With this method we feel the engineman has received sufficient practical instruction in the requirements of his duties.

Frank C. Goble, general air-brake instructor, New York, New Haven & Hartford, is the chairman of this committee.



Locomotive Maintenance Officers' Association

Employee suggestion systems, air brake, welding and heat treating reports in program

LIKE the other mechanical associations the Locomotive Maintenance Officers' Association did not hold any meetings during the year just passed but did greatly expand the work of its technical and other committees. In the pages which follow there will be found a group of comprehensive reports which have been developed as a result of the work of the committee on employee relations, welding, forging and heat treating, maintenance of air brake equipment, shop tools, and the maintenance of Diesel-electric locomotives. Two other committees of the association, the lubrication committee and the committee on improved maintenance practices, were not able to complete their reports in time for inclusion in this issue.

The report of the committee on employee relations and supervisory training has, as a result of contact with a number of railroads, compiled a report dealing with the results that have been secured with employee suggestion systems and the organization required in carrying on this type of effort. The welding report deals with a number of advanced ideas in welding practices developed, in many cases, in builders' plants, that may be adapted to steam locomotive practice. The forging and heat-treating report presents, probably for the first time, a "manual" of heat-treating, forging and flame hardening practice for the guidance of railroad shop men in that field of work. The air-brake report, as in past years, deals specifically with the maintenance practices and tool equipment required in overhauling a single item of equipment —in this case brake-pipe vent valves. The shop-tool report is a progress report on the use of modern cutting tools for the machining of locomotive parts, and the Diesel maintenance report deals exhaustively with the work that must be performed in the routine maintenance of that type of motive power.

There having been no election of officers during the past year the affairs of the association continue in the hands of the same men as in 1944.

W. H. Ohnesorge, Chairman

Forging, Heat Treating and Flame-Hardening Locomotive Parts

Report embraces material specifications, method of manufacture and heat treatment of a large variety of locomotive parts

This subject has been discussed by many organizations in the past and as a result there are many excellent text books some of which are highly technical while others are very general. None, however, treat the subject from a railroad standpoint. It is, therefore, the intention of this committee to develop a paper covering this subject that can be used by any railroad shop and if followed the user can feel assured that results will be satisfactory.

The information has been compiled from questionnaires that have been returned by leading railroads throughout the United States.

In order that we may all have the same understanding of terms used, it may be well to state a few definitions based on American Society for Testing Materials.

Heat Treatment.—An operation or combination of operations involving the heating and cooling of metal or alloy in the solid state for the purpose of obtaining certain desirable conditions or properties. (Note: Heating and cooling for the sole purpose of mechanical working are excluded from the meaning of this definition.)

Annealing.—A heating and cooling operation implying usually a relatively slow cooling. (Note: Annealing is a comprehensive term.) The purpose of such a heat treatment may be: (a) To remove stresses; (b) to induce softness; (c) to alter ductility, toughness, electrical, magnetic, or other physical properties; (d) to refine the crystalline structure; (e) to remove gases and (f) to produce a definite micro-structure.

In annealing, the temperature of the operation and the rate of cooling depend upon the material being heat treated, and the purpose of the treatment. Certain specific heat treatments coming under the comprehensive term annealing are: (a) Full annealing-heating iron-base alloys above the critical temperature range, holding above that range for a period of time, followed by slow cooling to below that range. (Note: The annealing temperature is generally about 100 deg. F. above the upper limit of the critical temperature range, and the time of holding is usually not less than one hour for each inch of section of the heaviest objects being treated. The objects being

Temperatures for Normalizing and Tempering Locomotive Forgings

Carbon	Manganese	Vanadium	Nickel	Normalizing temperature deg. F.	Tempering temperature deg. F.
0.45-0.45	0.50-0.85	.....	.....	1,500-1,550	1,000-1,100
0.45-0.50	0.50-0.85	.....	.....	1,475-1,525	1,100-1,250
0.50-0.55	0.50-0.85	.....	.....	1,450-1,500	1,200-1,350
0.45-0.50	0.70-0.95	0.15-0.25	.....	1,575-1,650	1,050-1,250
0.50-0.55	0.70-0.95	0.15-0.25	.....	1,575-1,650	1,050-1,250
0.35-0.40	0.50-0.80	.....	3.25-3.75	1,425-1,450	1,000-1,150
0.40-0.45	0.50-0.80	.....	3.25-3.75	1,400-1,425	1,050-1,200
0.20-0.30	0.80-1.00	.....	2.30-3.00	1,425-1,475	1,000-1,200

treated are ordinarily allowed to cool slowly in the furnace. They may, however, be removed from the furnace and cooled in some medium which will prolong the time of cooling as compared to unrestricted cooling in the air.)

Quenching—Rapid cooling by immersion in liquids or gases, or by contact with metal.

Normalizing—Heating iron-base alloys to approximately 100 deg. F. above the critical temperature range, followed by cooling to below that range in still air at ordinary temperature.

Case Hardening—A heat treatment or a combination of heat treatments in which the surface layer of an iron-base alloy is made substantially harder than the interior by altering its composition (carborizing or cyaniding, both of which are ordinarily followed by quenching, or by nitriding).

Flame Hardening—A process which embraces the use of the oxy-acetylene flame to raise the temperature of the surface of ferrous metals (iron and steel) so that subsequent quenching will produce a desired hardness and structure.

This process furnishes a hardened case on the surface of the parts being treated without altering the chemical composition. It must not be confused with such processes as carburizing, cyaniding, or nitriding that require an addition or absorption of other elements.

Critical Point—Critical Range—Reference: Metals Handbook, 1939 Edition. Page 366, subject "Constitution of Iron and Carbon Alloys," which gives a very satisfactory explanation of this subject.

Shop Equipment Needed

The following equipment is recommended to give the most satisfactory results from a heat-treating and financial standpoint.

Furnace Type—The car bottom furnace is recommended for all work requiring normalizing and tempering because by removing the car bottom it is more accessible for loading and unloading and assures proper blocking of work. The furnace should be constructed with a door at each end so that it also can be used for preheating billets for flame cutting.

A cooling shed should be located at one end of the furnace and the flame cutting house at the other end. This would permit normalizing without interfering with the flame cutting machine.

A solid bottom furnace is better for case hardening because parts requiring the greatest depth of case can be put in first, and those requiring a lesser case can be more readily removed without disturbing the furnace heat to any great extent. Also, a table should be constructed at the door of the case hardening furnace upon which pots can be placed when removed from the furnace.

Metal Container for Pack Carburizing—These should be made as light as possible from high temperature alloy sheet or plate, resistant to scale and corrosion and capable of rapid heat penetration in order to come up to required temperature quickly. The size and shape of the containers depends upon requirements. The seams should be properly welded and given a pressure test to prevent gas from escaping.

Gas Carburizing—A commercial electric furnace is recommended with a controller that regulates the temperature of the furnace, distributes the heat uniformly throughout the load, keeping the temperature uniform, as required, and feeds a constant amount of fluid to generate carburizing gas of definitely-controlled quality. Also, a chart giving necessary information to insure satisfactory results is desirable.

Liquid Carburizing—A pot type furnace is recommended (gas, oil, or electric, depending on local conditions) with automatic temperature controls, and a suitable quenching bath located adjacent to the furnace. Automatic control is recommended and most desirable because it requires less attention, insures a more even heat, and should give better combustion.

A recording pyrometer should be used for heat treatment, and an optical pyrometer for forging, and for work where a recording pyrometer is not necessary.

Medium of Quenching—This refers to the rapid cooling of a metal, usually, but not necessarily, by immersion in a liquid. There are two universally used liquid quenching media; namely, water and oil. The use of a cold bath to shorten the life of vapor formations and agitation such as in the submerged spray quench are recommended. The addition of common salt or sodium hydroxide will destroy the stability of vapor films and permit early cooling. Nine per cent common salt, or three per sent sodium hydroxide has been found to give maximum efficiency.

Shape Cutting—High-carbon steel (0.40-0.55 per cent) must be preheated and ⅜-in. stock or more must be left for machining to eliminate possible surface cracks and change in structural composition.

Heat Treating Locomotive Parts

The specifications referred to in this report will be A. A. R. or S. A. E. These specifications are standard throughout the country, and copies are available to all railroads.

The following data covering recommended practices are from replies to questionnaires received from several railroads.

For general guidance, the temperatures recommended by the American Society for Metals are included in an accompanying table. These figures are based on a single normalizing treatment with slow cooling in the furnace from the temperature. These temperatures may need modification to meet individual requirements.

Links (When Flame Hardened)

Specifications: AAR-M-105. Class A. Grade 3.

Method of Making: (1) Shape cutting. Recommended due to low cost of making. Care should be taken when ordering billets to procure proper size in order to eliminate waste.

(2) By forging. Recommended only when no shape cutting machine is available.

Heat Treatment: (1) Normalize; (2) Temper; (3) Flame-harden.

After links have been machined the link block wearing surface is then flame-hardened.

Note.—When links have been made out of AAR-M-105 Class A, Grade 2 and it is desirable to flame-harden, they may be heat treated as follows:

(1) Normalize; (2) Carburize. After links have been machined they should be carburized as follows: Pack links in metal containers using commercial carbonizing compound and seal the cover with fire clay to prevent gas from escaping. Place the containers in the furnace and heat for approximately 20 hr. (time depending on the depth of case desired). Allow links to cool in containers before removing.

Note.—As low-carbon steel can not be flame-hardened it is necessary to carburize before flame-hardening. (3) Flame-harden. After links are carburized flame-harden the link block wearing surface.

Links (Not Flame Hardened)

Specification: AAR-M-105, Class A. Grade 2.

Method of making: (1) Shape cutting recommended. (2) Forge, when shape cutting machine is not available.

Heat treatment: (1) Normalize; (2) Carburize. After links have been machined they should be carburized and allowed to cool. (3) Quenching. Reheat links and quench.

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1944-1945

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O. A. Garber

D. J. Sheehan

Link Blocks

Specifications: AAR-M-105, Class A, Grade 2.
Method of making: Forge in slabs approximately four blocks to the slab.
Heat treatment: (1) Normalize; (2) Carburize and allow blocks to cool. (3) Quenching. Reheat links and quench.

Eccentric Rods

Specifications: AAR-M-105, Class A, Grade 3.
Method of making: Forging recommended. However, good results can be attained by forging and shape cutting.
Heat treatment: (1) Normalize. (2) Temper.

Combination Levers

Specifications: AAR-M-105, Class A, Grade 2.
Method of making: Forging recommended.
Heat treatment: Normalize.

Valve Rods

Specification: AAR-M-105, Class A, Grade 2.
Method of making: Forging.
Heat treatment: Normalize.

Valve Stems

Specifications: AAR-M-104, Class A.
Method of making: Economy suggests the use of scrap piston rods provided they meet the above specifications and they should be made by the forge-and-draw method instead of the upsetting method in order to eliminate cracks at the collar when upsetting.
Heat treatment: (1) Normalize. (2) Temper. (3) Test specimens—A specimen should be taken from one valve stem representative of a group. If the specimen meets the requirements the stems can be accepted for use.

Union Links

Specifications: AAR-M-105, Class A, Grade 2.
Method of making: Either by forging or forging and shape cutting.
Heat treatment: Normalize.

Radius Bars (One-Piece, Not Flame Hardened)

Specifications: AAR-M-105, Class A, Grade 3.
Method of making: Either by forging or shape cutting or by a combination of these two methods.
Heat treatment: (1) Normalize. (2) Temper.

Radius Bars (Two-Piece, Flame Hardened)

Specifications: AAR-M-105, Class A, Grade 3.
Method of making: Forging.
Heat treatment: (1) Normalize. (2) Temper. (3) Flame-harden. After machining and cutting oil grooves in the tongue, flame-harden on the top and bottom.

New Main and Side Rods

Specifications: AAR-M-105, Class A, Grade 3.
Method of making: Forge and shape-cut the ends.
Heat treatment: (1) Normalize. (2) Temper. Each forging should be tested, by specimen, to make sure that it meets requirements.

Repaired Main and Side Rods

All rods should be Magnafluxed and cracked rods rejected. Worn surfaces, such as bushing eyes, sides of forks, etc., may be built up (when permitted) by electric welding, as follows:

(1) Rods which are to have surfaces built up are first preheated slowly on open fire of briquettes so that the heat extends well beyond the surface to be welded. The work is to be protected against drafts. The briquette fire is to burn under natural draft only. The temperature of preheating need not exceed 300 deg. F. to 500 deg. F. and must not exceed 800 deg. F., that is, not above black heat. Probably the temperature of the briquette fire is not above 800 deg. F.

(2) Welding is to be done by the electric process only, and by approved methods for building up metal. The work is to be properly protected and the rod cooled slowly.

(3) All rods repaired by welding (when welding is permitted) should either be re-heat-treated or stress-relieved. If stress-relieved only the temperature should not exceed the draw back or tempering temperature.

(4) If straightening the rod is necessary or fork eyes need closing or opening the rod may be heated locally for that purpos by an oil flame in the portion to be altered. The temperatur should not exceed the tempering temperature in any case—prefer ably not to exceed 1,100 to 1,175 deg. F.

(5) After straightening, the rod should be allowed to cool wit proper protection.

Brake and Spring Rigging Parts

Note.—This applies to such parts as slack adjusters, pull rod equalizers, etc.
Specifications: AAR-M-105, Class A, Grade 2.
Method of making: Forging and shape cutting.
Heat treatment: Normalize.

Brake Beams, Driving Box Equalizers, Etc.

Specifications: AAR-M-105, Class A, Grade 3.
Method of making: Forge and shape cut.
Heat treatment: (1) Normalize; (2) temper and (3) flan harden. Driving box equalizers flame hardened at box p Brake beams flame-hardened at hanger bearings or trunnion end

Brake Rigging and Spring Rigging Pins

Specifications: AAR-M-106, Grade B.
Method of making: These can either be forged or machin depending upon equipment and cost of making. However, a b ter case hardening can be obtained with a machined pin.
Heat treatment: (1) Carburize; allow pins to cool and (quenching; reheat pins and quench.

Brake Rigging and Spring Rigging Bushings

Specifications: S.A.E. 1020.
Method of making: Bushings can be machined from tubing.
Heat treatment: (1) Carburize; allow bushings to cool and (quenching; reheat bushings and quench.

Binders—Frame or Pedestal Caps

Specifications: AAR-M-105, Class A, Grade 3.
Method of making: Recommend shape cut, although some roa purchase heat-treated billets from which binders are machine This method eliminates heat treating.
Heat treatment: (1) Normalize. (2) Temper.

Note: When locomotives come into the shop for repairs and is found that wear has occurred at the pedestal fit the binders pedestal caps may be repaired by metal spray process as follows

Clean binders or pedestal caps at lye vat, then jack in plac on frame, using feelers to determine the amount of wear an mark the wear.

Remove binders or pedestal caps and sandblast surfaces that ar to be built up, making sure surfaces are clean. Do not touc the fit with the hands after sandblasting or metal will not adher

Apply the required amount of metal to the binder or pedesta cap fit to compensate for wear. It has been found that eac surface can be built up to approximately 1/16 in. and give good re sults. If metal has been applied too heavily, it can be removed wit a file when the mechanic is fitting it to the frame. This method where metal spray equipment is available, has been found to b better and cheaper than building up by welding and machining.

Axles (New)

Specifications: AAR-M-104, Class A.
Method of making: Recommend semi-finished heat-treated axles be purchased. However, a road desiring to forge axles from billets should comply with the following heat treating:
Heat treatment: (1) Normalize and (2) temper.

Axles (Reconditioned)

Specifications: AAR-M-104, Class A.
Method of making: Select axles worn below the journal limit and Magnaflux them, making sure they are not defective. Machine the axle to new sizes required, making sure all heat checks have been removed. Any axle machined to new size because of having been overheated should be Magnafluxed after machining
Heat treatment: Any axle showing severe conditions of overheating should be scrapped, or be re-heat-treated if no defects are found.

Crank Pins (New)

Specifications: AAR-M-104, Class A.
Method of making: Recommend semi-finished heat-treated

ank pins be purchased. However, roads wishing to forge crank ns from billets should comply with the following heat treating: *Heat treatment:* (1) Normalize and (2) temper.

Crank Pins (Reconditioned or Made From Scrap Axles)

Specifications: AAR-M-104, Class A.

Method of making: Select crank pins that are worn below limit nd Magnaflux them, making sure they are not defective. Ma- hine to new sizes required, making sure all heat checks have een removed, then Magnaflux again.

When using scrap axles the same care should be used as in econditioning crank pins.

Heat treatment: (Crank Pins Made from Scrap Axles). A lab approximately 1 in. thick should be removed from one end f the axle, polished and etched, and the axle scrapped unless the etal is generally sound. If the micro-structure is satisfactory, he carbon and manganese must be determined, and the axle heat reated to meet specification requirements. The above procedure s mandatory for all main crank pins made from scrap axles.

Flame-Hardening

The section of this report that dealt with flame-hardening consisted of a paper which was presented by F. C. Hasse, general manager, Oxweld Railroad Service Company, before the Southern and Southwestern Railway Club. This paper was published in the *Railway Mechanical Engineer* for December, 1942, and January, 1943. The flame-hardening portion of this committee's report also included sketches of a number of railroad applications of the flame-hardened process.—Editor.

The members of the committee were W. H. Ohnesorge (chairman), shop superintendent, B. & M.; Allan Perry, chief chemist, C. & O.; L. B. Herfurth, forging supervisor, Mo. Pac.; L. E. Grant, engineer of tests, C. M. St. P. & P.; E. J. Hausback, shop superintendent, Wabash; J. S. Miller, supervisor of welding, N. Y. N. H. & H., and H. E. Hoffman, Oxweld R. R. Service Co..

Maintaining Diesel-Electric Locomotives

A discussion of the factors involved in establishing maintenance schedules and an outline of the operations which must be performed periodically

T. T. Blickle,
Chairman

Many Diesel-electric locomotives of various types and designs have been placed in both yard and road service on the railroads in the last 10 years, the use of which has produced numerous methods of scheduling the maintenance required to keep equipment in proper condition, and at the same time maintain high availability.

The manufacturers, in most cases, have prepared maintenance schedules based on their own past experience which are available for use as a guide when setting up maintenance schedules.

It is necessary when setting up any maintenance schedule to have some predetermined value to work by in order to specify the proper intervals when certain items should receive maintenance. Yardsticks which may be used are mileage, time intervals, fuel consumption, hours of service, revolutions performed by the engine, or electrical output of generator; none of which give an absolute indication of the amount of work which has been performed by all parts of the locomotive.

The mileage made by a locomotive in a given period is dependent upon operating and grade conditions and train tonnage, and is not a consistent indication of the amount of work performed by the locomotive power plants. Mileage does, however, have a direct bearing on the service rendered by the wheels and the parts which are connected with them. The use of mileage as a yardstick for handling maintenance involves the keeping of numerous and accurate records and results in considerable clerical work, and is not a true indication in all cases of the amount of work performed by the power plant.

The use of time intervals such as each month, three months, six months, or twelve months as a yardstick for doing certain work on the locomotive is a very simple and convenient method of scheduling the work, due to the fact that government requires that certain work and inspections be made at the same intervals and records maintained accordingly. The grouping of maintenance items at certain time intervals is, of course, based on the assumption that the locomotive will be available and utilized as much as possible and will do sufficient amount of work during that time to warrant the scheduled maintenance, and it is necessary to take advantage of all out-of-service periods in order not to perform unnecessary maintenance.

Using Fuel as a Yardstick

The use of the amount of fuel consumed by an engine as a yardstick for scheduling maintenance requires that methods be provided for measuring the fuel and maintaining a record of the amount consumed by the locomotive. The amount of fuel consumed by a locomotive for power indicates quite accurately the amount of work which has been performed, but it does not indicate what the load factor was while the work was being done which has a very important bearing on the resulting condition of the engine. If the locomotive is equipped with steam generators a considerable amount of the fuel will be used for producing steam and, due to the above reasons, it is not deemed very practical to use fuel consumption as a yardstick for determining maintenance requirements.

The use of actual hours of service as a yardstick to determine when maintenance is needed requires maintaining an accurate record in order to determine what the actual hours of operation were, which is rather difficult to do inasmuch as the locomotive may be operating

in and out of several terminals and have some out-of-service time at each point, and is not a true indication of the amount of work done inasmuch as the load factor and operating conditions causing locomotives to be standing idle are not known.

To use the number of revolutions performed by the engine as a yardstick for maintenance, it would be necessary that the Diesel engines be equipped with a revolution counter. These counters give a true indication of the number of revolutions the engine has made, but do not indicate how many of the revolutions were performed with the engine idling or operating at partial or full load. An engine will require more maintenance per revolution when operating at a high load factor than when operating at low load factor, and due to this it also is not a true indication of the amount of work which has been performed.

The use of generator output as a yardstick for determining maintenance requires that the power plant be equipped with an instrument for recording the amount of energy produced. These instruments would give a true indication of the work performed by the generator but not of the work performed by the engine inasmuch as no current is generated while the engine is idling. The use of generator output as a yardstick for determining the amount of work done by the locomotive would not indicate all work performed by the Diesel engine or what the load factor was.

A survey of maintenance schedules now in effect on some of the railroads at the present time indicate that the common yardstick for scheduling maintenance on switch locomotives are time intervals such as the time of the monthly, quarterly, semi-annual and annual inspections as required by the government regulations, whereas mileage is used for the yardstick on road locomotives with a tendency to group the work items so that the majority of them will fall due at the same time as the government inspections and prevent holding the locomotive out-of-service unnecessarily. The practice of grouping the mileage work items on road locomotives so that they will fall due at the same time as the government inspections appear to be more desirable where large groups of Diesel-electric locomotives are being maintained as it simplifies the record keeping and general handling.

A few railroads have established classified repairs in their maintenance schedules covering the older types of equipment but the tendency at the present time on the more modern equipment is to handle the maintenance currently, and make heavy repairs as inspections indicate the work is necessary. No doubt as more knowledge is accumulated with the operation of Diesel-electric locomotives, it will be desirable and necessary to establish certain intervals for making the heavy repairs.

Owing to the numerous items contained in a maintenance schedule space limitations in this paper will not permit presenting schedules covering each type of locomotive, and only a general schedule covering switch and road locomotives will be given.

Diesel-Electric Switching Locomotives

Daily Inspections

Mechanical:

1—Inspect locomotive for defects.
2—Renew worn brakeshoes and adjust piston travel.
3—Test out sanders and fill sand boxes if needed.
4—Check fuel oil supply and refill, if necessary.
5—Check cooling water supply and refill, if necessary.
6—Check locomotive supplies and replenish, if needed.
7—Check fire extinguishers.
8—Drain moisture from air equipment.
9—Wipe up oil accumulations and eliminate all fire hazards.
10—With engine running, check for leaks, proper pressures and operation.
11—Check safety appliances.

Electrical:

1—With engine running check to see that batteries are charging properly.
2—Make visual inspection of electrical cabinets.
3—Test out all lights.

Lubrication:

1—Check condition of lubricating oil and supply in main engine and all accessories and replenish, if needed.

Weekly Inspections

Mechanical:

1—Change engine air filters.
2—Change waste packed lubricating oil filters, if necessary.

Electrical:

1—Check battery water and gravity.

Lubrication:

1—Check oil in traction motor support bearings.
2—Check oil in journal box bearings.

Monthly Inspections

Mechanical:

1—Check Diesel engine speeds.
2—Check setting of fuel injectors.
3—Make visual inspections of pistons and crankcase.
4—Check all vee belts for condition and tension.
5—Clean fuel filtering equipment.
6—Check condition of cooling system and flush, if necessary.
7—Clean all breathers.
8—Clean air compressor filters.
9—Clean locomotive interior and exterior.
10—Check operation of emergency fuel cut-off valve.
11—Make all inspections as required by law.
12—Check cylinder head mechanism with engine idling.
13—Check all bolts.
14—Inspect all engine auxiliaries.

Electrical:

1—Check auxiliary generator voltage.
2—Inspect and clean all motors and generators and renew brushes where needed.
3—Inspect and clean all electrical equipment and auxiliary equipment.
4—Check high and low voltage systems for grounds.

Lubrication:

1—Lubricate traction motor gears.
2—Grease throttle linkage, governor linkage and shutter linkage.
3—Grease all fans.
4—Grease generators and traction motors.

Quarterly Inspections

Mechanical:

1—Make all inspections as required by law.
2—Check calibration of temperature and pressure gauges on the engine.

Lubrication:

1—Change lubricating oil in engine, clean all strainers and wash down lubricating oil system.

Semi-Annual Inspections

Mechanical:

1—Make all inspections as required by law.

Lubrication:

1—Change air compressor oil.
2—Grease flexible couplings.

Annual Inspections

Mechanical:

1—Make all inspections as required by law.
2—Inspect engine bearings.
3—Recondition air compressor valves.
4—Recondition locomotive paint where needed.
5—Recondition pistons and cylinder heads where inspection shows necessary by test.

Electrical:

1—Make inspections as required by law.
2—Overhaul fuel pump motor.
3—Clean and paint exposed wiring and cables.
4—Check settings of relays.

Two-Year Inspections

Mechanical:

1—Remove and recondition pistons, heads and liners.

Four-Year Inspections

Mechanical:

1—Overhaul air compressor.

Electrical:

1—Overhaul traction motors and auxiliary generators.

Road Locomotives

After Each Trip or Day's Work

Mechanical:

1—Check fuel oil supply and refuel, if necessary.
2—Check engine cooling water supply and refill, if necessary.
3—Check boiler water supply and refill, if necessary.
4—Check brakeshoes and renew those worn down to minimum thickness.
5—Inspect locomotive for defects.
6—Clean locomotive and eliminate all fire hazards.
7—Inspect all fire extinguishers and maintain in operating condition.
8—Test out sanders and fill sand boxes if needed.
9—Test out air brake equipment according to outstanding instructions.
10—Inspect cylinder assemblies applied previous trip and retighten if necessary.
11—Adjust brake cylinder piston travel.
12—Check locomotive supplies and replenish if necessary.
13—Drain moisture from air equipment.

Electrical:

1—Test out all lights.
2—Make visual inspection of all electrical cabinets.
3—Test out locomotive for proper operation and control.

Lubrication:

1—Check lubricating oil supply in all equipment and replenish if necessary.
2—Fill lubricating oil supply cans.
3—Check condition of lubricating oil.

2,500-Mile Inspection

Mechanical:

1—Inspect cylinder head mechanism with engine idling.
2—Inspect pistons, liners and interior of crankcase.
3—Clean engine air filters.

Semi-Monthly (5,000 Miles Freight Service; 10,000 Miles Passenger Service)

Mechanical:

1—Inspect condition of cooling system.
2—Inspect V belts for condition and tension.
3—Removve and repack waste type lubricating oil filters. Filters should be changed whenever oil becomes dirty.

Electrical:

1—Inspect traction motors, main and auxiliary generators and renew worn brushes.
2—Check battery water and gravity.

Lubrication:

1—Check oil level of traction motor suspension bearings.
2—Lubricate traction motor gears.
3—Check oil level in journal boxes.

Monthly Inspection (Approximately Each 10,000 Miles Freight Service—20,000 Miles of Passenger Service)

Mechanical:

1—Load test Diesel engines at full load for at least 30 min. and do the following: (a) check Diesel engine speeds; (b) inspect for leaks; (c) check governor operation; (d) check all pressures and temperatures and maintain a record and (e) remove and clean oil coolers if temperature is excessive.
2—Blow out radiators.
3—Clean car body filters.
4—Clean air compressor air filters.
5—Clean all breathers.
6—Drain condensation from fuel filters and tanks.
7—Clean fuel filters.
8—Check operation of emergency fuel cut-off valve.
9—Make all inspections required by law.

Electrical:

1—Clean and inspect all motors and generators.
2—Clean and inspect all electrical equipment.
3—Check locomotive for grounds.
4—Check operation of all alarm devices.
5—Check auxiliary generator voltage.

Lubrication:

1—Grease fan and blower bearings.
2—Grease all control linkage.
3—Grease all traction motor bearings.

Each Two Months (Approximately 20,000 Miles of Freight Service—40,000 Miles of Passenger Service)

Lubrication:

1—Change engine lubricating oil.

At Time of Quarterly Inspection (Approximately Each 30,000 Miles of Freight Service—60,000 Miles of Passenger Service

Mechanical:

1—Make all inspections required by law.
2—Check fuel injection timing.
3—Check and adjust valve clearance.

Electrical:

1—Inspect and clean voltage regulators.
2—Inspect and clean dynamic brake grids.
3—Inspect and clean control stand.

Lubrication:

1—Grease all flexible couplings.
2—Change air compressor oil.
3—Grease main generator.

At Time of Semi-Annual Inspection (Approximately 60,000 Miles of Freight Service—120,000 Miles of Passenger Service)

1—Make all inspections required by law.
2—Remove, clean and calibrate speed recorders.
3—Remove, clean speed recorder drive cable.
4—Check crankshaft and thrust.
5—Drain and flush engine governor.

At Time of Annual Inspection (Approximately 120,000 Miles of Freight Service—240,000 Miles of Passenger Service)

Mechanical:

1—Make all inspections required by law.
2—Remove and recondition air compressor valves.
3—Remove and inspect engine main bearings.
4—Check all thermometers.
5—Check settings of hot engine and low oil pressure alarm devices.

Electrical:

1—Clean and paint all exposed wiring and cables.
2—Overhaul fuel pump motors.
3—Test all relay settings.
4—Check tightness of all terminals and wiring connections.

Lubrication:

1—Oil all electro-pneumatic control cylinders.
2—Lubricate reverser.

Each 200,000 Miles

1—Overhaul traction motors.

Each Two Years (At Time of Annual Inspection)

1—Dismantle, clean and inspect engine governor.
2—Recondition air compressor.
3—Recondition all contactors, and reversers and control equipment.

Each Three Years (At Time of Annual Inspection)

1—Inspect engine drive gears and chains.
2—Inspect engine blowers and turbo-chargers.
3—Recondition auxiliary generators.

As mentioned previously, the above schedules do not apply to any particular type of locomotive and is intended only as a general guide as each type of locomotive is of different design and requires the maintenance of certain items which are used on that type of power only.

The frequency of lubricating oil change depends en-

tirely on the condition of the oil which can only be determined properly by making a chemical analysis.

The removal of pistons for reconditioning based on mileage or time intervals, results in unnecessary piston pulling as many times the cylinders are still in good condition, and considerable piston pulling can be eliminated by careful inspections being made by properly trained men. There are, however, occasions when it is desired to operate engines for set periods of time which requires that the pistons be in condition to operate for that period and to do this it is necessary to condition the engine to operate for that period. To do this it is necessary to remove the pistons periodically. These are operating conditions which have a direct bearing on the method of maintaining the locomotive.

The scheduling of Diesel locomotive maintenance in the future no doubt will change as more experience is gained and new designs are developed which will bring about improved performance by the locomotive.

The members of the committee are T. T. Blickle (chairman), supervisor of Diesel engines, A. T. & S. F.; E. J Feasey, chief inspector of Diesel equipment, Can. Nat. R. I. Fort, mechanical inspector, I. C.; J. E. Kilker supervisor of Diesel equipment, Mo. Pac.; R. W. Murray general supervisor of Diesels, Seaboard; P. M. Rooker general mechanical instructor, A. C. L.; R. G. Tausch Diesel supervisor, Gr. Nor.; H. E. Taylor, Diesel superintendent, Southern; J. H. Whipple, Diesel, supervisor D. & R. G. W., and G. P. Wiles, general supervisor of Diesel electrical equipment, B. & O.

George E. Bennett

Use of Welded Parts Can Be Extended

Observation of welding practices and equipment in the builders' plants leads to the conclusion that the railroads can profit by the new methods

The subject selected this year is that of fabrication best illustrated by the builders of Diesel locomotives. What a revelation it is to walk through the well equipped shops of the builders of Diesel power. It is time well spent to see the developments made in technique, positioners, testing laboratories and equipment especially designed to further progress in welding.

There is no reason to believe that many of these methods are not applicable to the building and maintenance of steam locomotives. It is true that we who have been associated with steam locomotives are slow to see the possibilities of welded fabrication.

The old axiom "necessity is the mother of invention" has been brought home to all of us many times in the past four years. The number of accidents has increased at least proportionately to the increased mileage, and has presented a number of problems in locomotive parts replacements. Little-used deck plates, pilot beams, engine and trailer truck frames, etc., have had to be replaced where the pattern cost and delay in the making of a pattern, along with delay in the casting of parts, just did not fit into the picture of increased demand for power. What did we do? We turned to the cutting torch, the arc welder, the normalizing furnace, and in some instances, to the X-ray and Magnaflux methods of testing and found that not only could we fabricate the part quicker, but also better in quality of construction, physical and chemical properties, and at lower cost.

Equipment Need Not Be Elaborate

Equipment for the average shop need not be elaborate. Proper welding machines, well maintained, and well trained welders are the prime requisites. Needless to say the correct electrode is also of importance. Inasmuch as the average shop cannot be classed with the production shops of industry, we find it impossible to justify the cost of elaborate positioners. However, with a little ingenuity, positioners can be built at low cost in the shop to handle such work as we want to.

One of our larger railroads has successfully fabricated driving boxes at lower cost than the conventional cast steel, and they have proved to be of greater strength The method is as follows: A three-piece design was followed; a center section and two side sections were flame cut from a billet. The center section was beveled inside and out to secure 100 per cent penetration and welded, using a reverse polarity shielded arc rod of $\frac{3}{16}$ in. and $\frac{1}{4}$ in. diameter. The forging was then stress relieved at 1,000 deg. F. after welding.

Another railroad reports driving box grease cellars fabricated as follows: (The dimensions given are to help describe the procedure and can be altered to suit). The material used is two pieces 8-in. by 6-in. by $\frac{7}{16}$-in. angle iron, one piece for the end is mild steel, $\frac{3}{8}$ in. thick, size to suit, and one piece $\frac{3}{4}$-in. by 1-in. by 8-in. mild steel. The angle iron is cut to suit for length, one edge planed and veed for width. The end piece is veed on the bottom and the edges and tack welded flush with one end. A piece of $\frac{3}{4}$-in. round open-hearth steel is then tack welded from the top in a flat position. The end plate is then welded in. The $\frac{3}{4}$-in. by 1-in. by 8-in. piece is welded on bottom, $\frac{5}{8}$ in. from the inside end; this piece is not veed. A single pass fillet weld across each end and on the side next to the inside end of the cellar is used. A pad 1 in. by 3 in. is built up on each corner, thickness to suit, for fit in the driving box. Clearance for the journal is then flame cut in the end piece and the edges planed to suit. The cellars are not stress relieved. After removing the $\frac{3}{4}$-in. rod, a blow in the line of the weld with a medium weight hammer removes the slight warpage.

Air Pump Brackets

The same road also fabricates double air pump brackets or application to the front end of locomotives as follows: This bracket is made of 1-in. scrap boiler plate; he sides are 32 in. high, 28¼ in. wide and 49 in. in ength. The procedure adopted in fabricating the bracket s as follows: Bend two pieces 1 in. by 28¼ in. by 56¼ n. each, to form one-half of the bottom and one end; two ieces 1 in. by 32 in. by 45 in. were flame cut to form two ibs to be welded inside the bracket 4⅜ in. from the edge, ront and back. The back ribs were cut to the contour f the smokebox, making the rib height 26 in. in the enter. The front rib was cut to 12 in. height in the enter on 8 in. radius at the lowest point. Two 12-in. quare openings were cut in the back rib spaced 5 in. rom the bottom and sides, respectively. Two triangular penings are cut in the front rib, spaced 5 in. from the ottom, sides, and angle at the top edge of the rib. After ending the two pieces to make the bottom and ends, they re tacked together and the ribs tacked in position. The ibs are not veed, and are welded by alternating the welds o compensate for stresses, using stringer beads to make ⅜-in. fillets. Four pieces 1-in. by 3½-in. by 45-in. open-earth steel, with ¾-in. lug turned at right angle on one nd of each, to form bottom lugs for pumps, were then velded on each, outside corner flush with the edges. A ⅜ in. fillet across each end and one stringer bead along ach side secured these pieces to the bracket. The edges f the bracket were heated and squared up after welding. No other stress relieving was done on it. Reverse polarity rods, 3/16 in., were used.

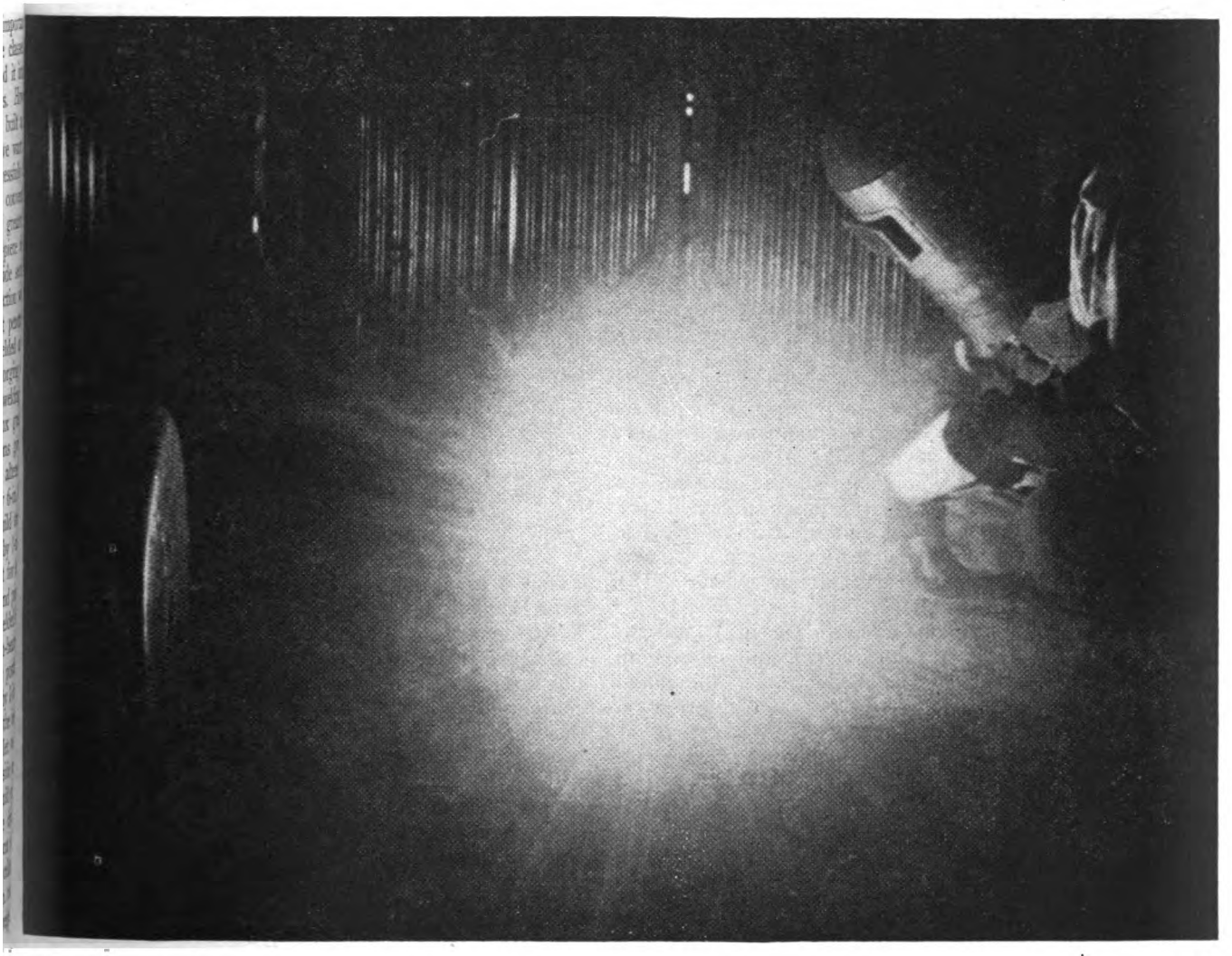
The above described parts are just a few of the many we find possible and from the methods described, it is easy to see how many parts can be fabricated, such as light-weight crosshead shoes, main cylinders, guide yokes, valve gear frames, step plates, stiffener ribs, and gussets, bolsters, draft gear assemblies, front and back deck plates, frame braces, smoke stacks, bases and lift pipes, feedwater pump brackets, indented feedwater tanks, tender underframes and cistern, front and back cylinder and valve chamber heads, engine truck and trailer cellars, pilot beams, various pipe fittings, throttle lever brackets, ash pans, boilers, and a thousand and one other parts.

The general practice in most parts is to use low-alloy, high-tensile steel, thus giving a part of greater strength and lighter weight. We all recognize the fact that when down-hand welding can be used, it is much superior in quality and the cost is lower. This can be attained by the use of proper positioners.

It is impractical to give figures in dollars saved through fabrication as practically all parts differ on various railroads. But those interested will find methods and techniques that will open their eyes to possible economies.

It is also well to remember that stress relief is of great importance and most of all the fabricated parts should be stress relieved or normalized. This can be accomplished by the use of a furnace of regular or car-bottom style or adequate size to take the entire part.

* * *



There are several makes of automatic flame cutting machines on the market, which can be used to a great advantage when more than one of a part is to be fabricated. This again will lower costs of fabrication.

Another fact brought out by all members of the committee and well worth considering is that welding is an art that involves manual skill and constant practice for the best results. The railroads have many men doing welding intermittently, who would show remarkable improvement in skill if they were regularly assigned.

The railroads would find it practical to appoint a man to push welded design. He must have the initiative necessary for leadership against the forces of tradition, as there will always be those with old ideas. He must always keep a deep-seated faith in the soundness of arc welding and the methods of fabricating to cut costs and improve quality. A man who has the practical knowledge and experience in welded design and production is going to do a lot in the post-war period when the railroads will be striving to keep ahead of other means of transportation.

The members of the committee are George E. Bennett (chairman), shop superintendent, C. & E. I.; Harry M. Moreland, welding supervisor, C. & O.; Ralph G. Fagerburg, assistant boiler foreman, Alton; M. A. Thompson, foreman welder, B. & M.; Bernard Wallard, welding instructor, C. & N. W.; and Emerson Murray, welding instructor, C. & E. I.

F. K. Mitchell,
Chairman

The Experience of American Railroads With Employee Suggestion Systems

A report of the Committee on Employee Relations outlining the advantages, disadvantages and results obtained from such systems

This Committee has undertaken a study of the so-called "Employee Suggestion Systems" in operation on railroads in order to give the membership the benefit of such data as were found available and our observations on pertinent related problems.

In the process of collecting this information questionnaires were forwarded to those railroads which, according to our best information, had such systems in operation. These questionnaires requested information on: (1) The type of system; (2) how sponsored; (3) brief description of its working; (4) title of officer supervising the system; (5) how suggestions are screened; (6) how accepted suggestions are tried out; (7) basis of awards; (8) maximum and minimum awards paid; (9) total number of employees eligible to submit suggestions; (10) average total suggestions received per month; (11) average total suggestions accepted per month; (12) estimated annual administration expense and savings; (13) how any patent expense is defrayed; (14) ownership and other patent arrangements; (15) difficulties experienced, and (16) benefits derived.

The detailed information received through these inquiries is of a confidential nature and in our discussion, therefore, no mention will be made of the individual railroad or company whose data or other information is quoted.

The total number of employees eligible to submit suggestions, as reported by those companies from whom replies were received, was 382,033. The same companies reported a monthly average of 10,813 suggestions received. The total monthly average number of acceptable suggestions received was 2,685. The average length of time during which these systems had been in effect was 8 years 4 months. It will be observed, therefore, that the experience analyzed by the committee was sufficiently extensive to afford some logical broad conclusions to be drawn. This, we believe, is true with the exception of two pertinent questions, namely, the cost of administrating such a system and the savings which might be expected. No company to which the questionnaires were addressed offered any information thereon.

Without exception each of the companies whose systems were studied, are using what might be termed an anonymous system. This term is derived from the fact that a bonafide attempt is made to prevent any partiality on the part of the judges responsible for accepting or rejecting suggestions by providing that all suggestions submitted carry no reference to the name of the employee making the submission. This is accomplished either by having all ideas submitted on standard numbered forms, the employee retaining a stub having the same number, or by the submission carrying only the employee's check or payroll number. Thus when the merits of the suggestion are under discussion, the committee has no knowledge of the identity of the originator.

Machinery of Administration

The general machinery set up to administer these systems is as follows:

At the head of the so-called system is a supervisor, or manager, who has general supervision over its entire functioning. Under him is a general committee. This committee is usually composed of department heads, or their selected representatives, and an equal number of representatives from the labor groups. This committee is the body which has the final decision as to whether suggestions are acceptable or not. It has regular meeting times and is supposed to be furnished with copies of the current suggestions sufficiently in advance of the next meeting to give it an opportunity to check for duplications and to study the merits of each. It likewise fixes the amount which is to be paid for each acceptance.

In the case of larger companies, local joint management-labor committees are set up. The function of these local committees is to screen those suggestions submitted by employees in certain local areas or shops. This committee ordinarily does not have the final decision as to acceptance, but does have powers to reject any obviously impractical or unsound suggestions. Neither does this local committee have a voice in deciding the amount to be paid for a suggestion. Its function is to pass on to the general committee for final action such suggestions as are, according to its judgment, worthy of further consideration.

Further than the above, the system provides media for keeping employees interested and some simple method of getting suggestions before the appropriate local or general committee, such as providing necessary forms, use of company mails and/or suggestion boxes located at convenient places from which regular collections are made.

It was found in our study that the practice exists universally of dividing suggestions into two categories—those from which tangible savings can be expected, and those from which no tangible saving can be expected. Minimum awards for accepted suggestions which fall in either category have usually been established as $5.00. Maximum awards are made on a different basis for suggestions in both categories. It is almost the universal practice that the award for an accepted suggestion from which tangible savings can be expected is on the basis of 10 per cent of the estimated annual savings. In making awards for suggestions from which no tangible saving can be expected, the award has been entirely dependent on the judgment of the general committee as to its value. Maximum rewards ranging up to $2,605 for a single acceptable suggestion were reported.

All suggestions received are considered the property of the company, after awards have been made to their originators. Such suggestions as are patentable, and if in the judgment of the company it is desirable to do so, are patented. In these cases the company defrays reasonable expense of search and patent proceedings, obtaining the patent in the name of the suggestor in exchange for a license agreement covering its use by the company. This arrangement seems to have worked out satisfactorily to all concerned and no controversies were reported to have arisen between the parties.

On the other hand, it is apparent that other features in connection with suggestion systems have been troublesome. One road reported having dropped the idea because of spotty employee response and waning interest and enthusiasm. Other reported difficulties were:

A tendency on the part of some supervisors to feel that a suggestion from anyone relating to his department is a reflection on his ability and methods.

A tendency on the part of some labor organizations to discourage their members from submitting suggestions which might result in reducing man-hour requirements.

A failure to allow the general committee sufficient time and opportunity to determine the merits of a suggestion before having to establish a reward for it.

The inability of the general committee to make an accurate forecast of the annual savings and being faced with the necessity of making an on the spot decision as to the amount of the reward.

Advantages of the Systems

Despite the difficulties which have arisen, the majority of reporting roads and companies consider that the benefits derived from the suggestion system far more than offset them. Some of the advantages stressed were:

Improves employee relations by establishing a feeling that the employee is a part of management.

Increases the employees' interest in their work.

Encourages initiative, observation, analysis and constructive thinking by providing a channel through which ideas pertaining to the employees' work can be submitted without fear of criticism.

Provides financial benefit to both employer and employee.

On the strength of the foregoing, the Committee feels that the adoption of an employee suggestion system might be anticipated to produce results, both positive and negative, in the locomotive department somewhat along the following lines:

You might expect to receive suggestions from about three per cent of your employees each month. This ratio would be higher to start with and taper off to about that figure.

Of the suggestions received you might expect about one-quarter of them to be acceptable. This ratio would probably start lower and increase to about that figure as the employees gradually learn the type of suggestion which is worthwhile.

You might expect that at the outset a large number of suggestions would not be suggestions at all but rather grievances expressed through the media of the suggestion system. Further, however, you might also expect a recession of this type of so-called suggestion, but not a cessation of them, as time went on. We believe that if you adopted a sensible, fair method of disposing of this type of problem during the screening process, very few grievances would eventually be advanced through these channels.

You might expect opposition from some supervisors and some labor representatives. Opposition from the first group might be due to jealousy and a feeling that any such suggestions are a reflection on the supervisors in the departments from which the suggestions come.

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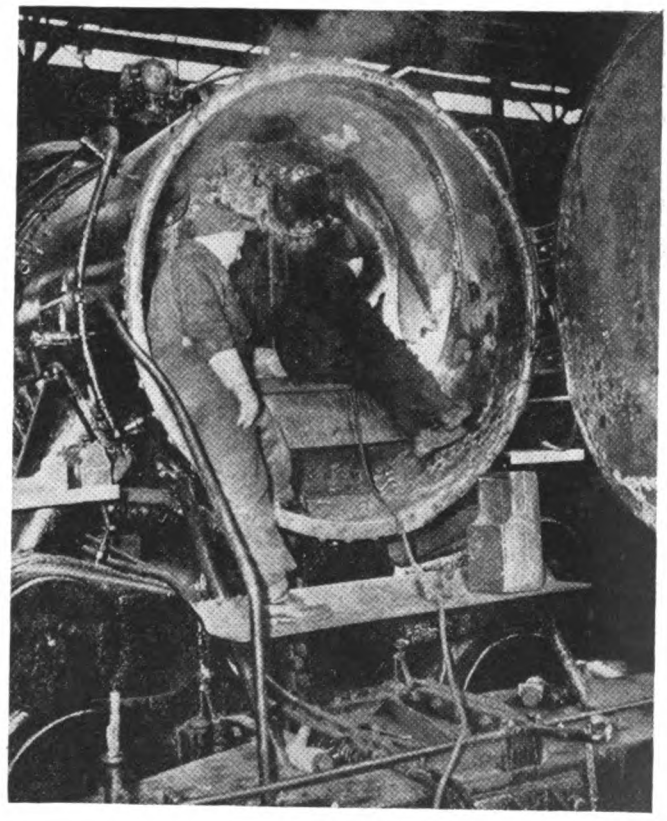

Diplomatic handling of this matter would be necessary but effective in eliminating it. You might expect that opposition from the second group would arise due to a fear that, through the adoption of certain suggestions, management might take advantage of them to reduce employment. This poses a real problem, for there is no contradicting the fact that such a thing might occur. This, however, may be offset by the fact that greater efficiency in railroad maintenance and operation will strengthen the railroad in its spirited competition with other types of common carriers—some of which are at least partially subsidized—and thus insure greater stability of employment for railroad employees.

Objections May Be Expected

You might expect objection on the part of both supervisors and men to the method of establishing awards for suggestions capable of producing tangible savings. Establishing such rewards on the basis of estimated annual saving is, we believe, not fair to either the company or the employee. We gather from the data reported that this basis was adopted in order to avoid the necessity of setting up the necessary machinery for determining the actual saving produced. This conclusion is based on the repeated statement that no estimate of the total annual savings produced by the employee suggestions system could be given because no procedure had been set up to produce that information. We hold that no committee, regardless of the experience and background of its members, can forecast the annual saving which any suggestion may produce, this being particularly true where a decision must be reached within a few days or weeks after the suggestion comes to their attention and before it has been given actual trial. We further hold that in this consideration, as in all others, if a job is worth doing at all, it is worth doing right, and that therefore the actual annual saving should be developed by trial before the final award is made even though this means off-setting the total saving by the clerical and supervisory expense necessary to establish the actual saving over the period of a year. By so doing, a guarantee to management that it is not paying for a saving which might actually be far less, or even a loss, and a guarantee to the employee that his award was commensurable with its actual merit would be established. We would, therefore, suggest that the objection under discussion could best be met by payment of a lesser initial award, augmented at the end of a year by a fixed percentage of the actual saving.

Finally, the committee feels that if the objections it has pointed out are overcome, either as recommended by us or in some other satisfactory manner, and a system in all other respects the same is kept honest, open and above criticism, the motive power shop and terminal operations will be benefited by the adoption thereof, which in turn means that the road as a whole will reap the benefits which have been mentioned.

The members of the committee are F. K. Mitchell (chairman), assistant general superintendent motive power and rolling stock, N. Y. C.; C. F. Brooks, mechanical engineer, Erie; K. Berg, superintendent motive power, P. & L. E.; W. V. Hinerman, assistant to superintendent motive power, C. & O.; H. J. Schulthess, chief personnel, D. & R. G. W.; A. H. Williams (retired) and Roy V. Wright, editor, *Railway Mechanical Engineer*.

A. Malimgren,
Chairman

Maintenance of Air Brake Equipment

A detailed description of the operations involved and the special tools needed for making repairs to brake pipe vent valves

Before assembling the KM vent valve, all parts should be carefully inspected. Referring to Fig. 1, check the 1/16-in. stabilizing port in the piston rim (note the drill in the piston rim) and the port in the unseating pin (note the No. 30 drill in the side of the unseating pin). With the older style piston and bushing assembly, the charging choke is screwed into the piston face. This choke should be cleaned and checked with a No. 77 drill. In the latest modification, this choke is blanked and the charging port is drilled through the bushing wall (see Fig. 2 showing a No. 77 drill projecting through the outer side of the bushing wall).

Check the alignment of the unseating pins with Tool A (Fig. 1) which is bored in three steps to conform to the three diameters and length of steps on the unseating pins. With the unseating pins housed in Tool A, leaking or loose pins may be swedged or tinned without any chance of misalignment.

Tool B is also bored in three steps to conform to the

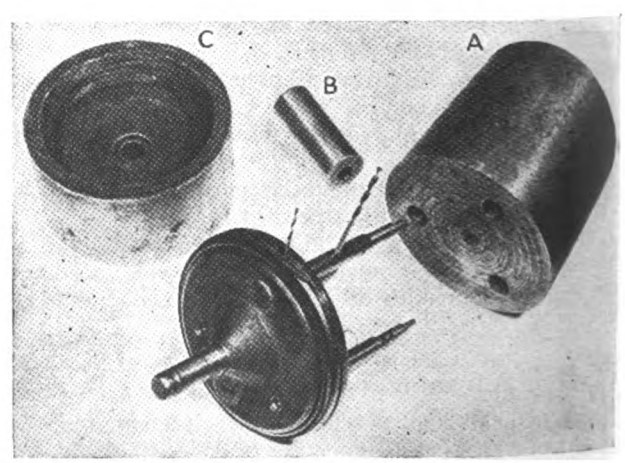

Fig. 1

diameters on the unseating pins. It is used as a gauge to check wear, such as fins, that may develop from lifting the pilot and main vent valve and to determine that the pins are not bent.

Tool C is used to grind the face of the piston gasket to insure the removal of any irregularities or high spots and obtain a uniformly thick gasket so that the piston will readily seal on its bushing seat with a minimum of pressure on the piston. Slightly worn gaskets may be reclaimed with Tool C. The shoulder or collar of Tool C which provides the cutting base is covered with an abrasive cloth or paper which is glued to this base and against this cloth the piston gasket is rubbed or

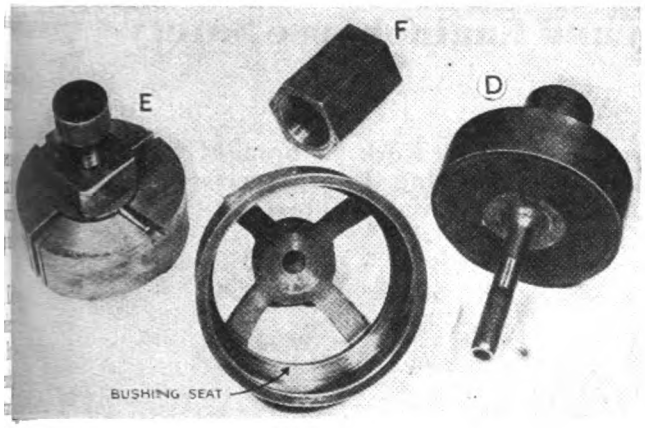

Fig. 2

ground. The pilot hole in the center of Tool C is concentric with the face of the piston gasket which is guided by the piston stem.

Clean and check the charging port on the inner wall of the bushing with a No. 77 drill. This is shown in Fig. 2. Usually it is found that a No. 77 drill is loose and the next larger size, No. 76, is a tight fit in this port.

Check the bushing seat for slight nicks which are polished or rubbed out with Tool D. This is the seat against which the piston gasket seals and, like the gasket, it must be in correct alignment to permit easy sealing of the gasket (not requiring heavy piston pressure to indent the gasket to make a seal or separation of the brake pipe and quick-action chamber).

Tool E is a grinder to smooth away scratches or cuts or any unevenness due to wear on the inner face of the piston bushing. Uniform bearing of the piston packing ring on the walls of this cylinder is just as important as it is in any other form of triple or control valve.

Tool F is a holder screwed on to the guide portion of the bushing to hold the bushing in a vise for the above operations.

Tool G (Fig. 3) is a holder for the main vent valve. With the main vent valve securely anchored to Tool G, Wrench H is used to remove the main vent valve seat whenever it becomes necessary to replace the gasket seal. At the same time, the application of the main vent valve to Tool G automatically checks the condition of the holes that fit on the unseating pins. A similar tool is used to check and straighten the legs on the pilot valve, but is seldom used as no distortion is found in service wear.

The tools described, with the exception of Tool E, were shop made.

The latest test code requires a check of the ability of the piston seal to seat easily against the bushing seat. This test is made by restricting the charging rate of the brake pipe, after a 15-lb. reduction has been made. A ⅜-in. by-pass pipe with a No. 10 drill choke provides the means for retarding the rate of build up in the brake pipe volume pressure and on the face of the piston. If the gasket seal on the piston does not seal against the bushing seat with this test, the quick-action chamber of the vent valve will charge rapidly with the brake pipe rise. If the piston gasket does seal properly it will require eight or more seconds to charge from 55 lb. to 67 lb. This test is a real check on the condition of the packing ring fit, the piston gasket and the bushing seat. In our shops it is common to find 11 seconds are required to charge from 55 lb. to 67 lb.

The pilot valve and main vent valve will fit freely on the unseating pins if the alignment is as it should be and parts pass the checking tools.

No. 4 Brake Pipe Vent Valves

Before assembling the No. 4 vent valve all parts should be carefully inspected. If the vent valve reservoir is not removed from the locomotive, the ⅜-in. and ½-in. drain plugs should be removed and the interior chamber thoroughly blown out with compressed air. If the inner walls of the chamber are rusted, the reservoir should be removed and cleaned in a lye vat, thoroughly washed and scaled and then given a bath in hot paraffin. If this treatment is given when locomotives are stripped in the shop, it is reasonable to expect rusting will not occur between shoppings.

Check and clean the 1/16-in. charging port in the cylinder bushing, and the No. 72 drill choke in the bushing underneath the ½-in. ball check valve. Check the condition of the piston bushing, packing ring and piston groove, noting that the bushing is true and the packing ring is correct size for the bushing. Friction must be kept to a minimum and the packing ring fit in the ring groove and the end cylinder walls should be as correct as it can be made. Excessive friction is the usual cause for undesired emergency. Examine the slide valve and its seat for cuts, etc., that may produce friction and leak-

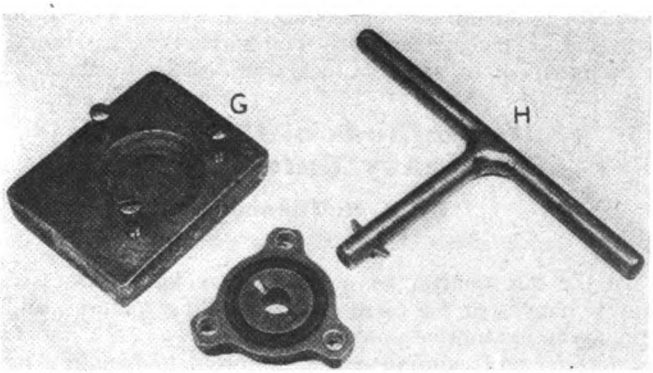

Fig. 3

age, and piston stem and slide valve bushing for shoulders or worn places that may cause undue resistance to piston movement.

The graduating stem in the piston and its stop in the reservoir must be checked for wear. It is important that the stem in the piston contacts the stop in the reservoir when the service port in the slide valve is wide open to the exhaust port. Over travel may restrict the service port and cause undesired emergency. When the reservoir is removed for cleaning the gasket face the reservoir should be examined for rust pits and if necessary machined to a true seat, taking care to maintain the original dimension between the gasket face and the piston stop. If the piston stop is eaten away, and requires refacing,

it may be necessary to reface the gasket face to maintain the original dimension between the piston stop and the gasket face.

The strainer in the No. 4-B vent valve plays an important part in keeping water and dirt from the piston cylinder chamber. Water and dirt cause high friction and lead to undesired emergency; hence, the strainer should be maintained in the highest degree of efficiency at all times. The cylinder bushing should be kept true and polished by using a bushing grinder as shown in Fig. 2. With a true bore in the cylinder, a stuck packing ring may continue in service until the cleaning date without causing any trouble or erratic action. On the other hand packing ring leakage may prove very detrimental, particularly on roads that permit the use of release position when releasing train brakes.

The report was signed by A. Malmgren (chairman), assistant superintendent, St. L.-S. F.; A. J. Pichetto, general air brake engineer, I. C., and W. E. Vergan, supervisor air brakes, M-K-T.

Promoting Shop and Enginehouse Safety

Safety in car and locomotive work is brought about by hiring good men, training them properly and educating the foremen to watch the results

E. L. Henry, Chairman

This year's report of the Committee on Safety consisted of a group of individual papers on various phases of the subject of safety in car and locomotive shops and enginehouses. Two of these are abstracted below. Other papers were submitted by G. A. Robinson, assistant general safety agent, Chesapeake & Ohio; J. L. Chapman, machine and erecting foreman, Illinois Central; O. B. Cavanaugh, master mechanic, Northwestern Pacific, and Norman Peterson, assistant shop superintendent, Boston & Maine. The chairman of the committee is E. L. Henry, superintendent of safety, Chicago & North Western.

Safe Methods of Handling Heavy Material

By H. H. Thomas,

Superintendent Shops, Chicago & North Western

In the last quarter of a century we have witnessed many changes in the methods of handling material and appliances for motive power.

Material and equipment are subjected to handling by various kinds of equipment—overhead traveling cranes, improved drop tables, transfer tables, power unit cranes, power lift trucks, power fork trucks, tractors, electric or air-powered hoists, air powered jacks, and numerous other lesser devices. Slings and attachments used in conjunction with the above equipment should be designed to expedite work safely.

All material from small items up to the largest castings, boilers or bundles of jacket steel weighing from 100 lb. to 50 tons, must be handled with the proper safety factor in mind.

More pliable slings made of braided cable which are easier to handle are in extensive use now. Cables must be inspected for wear and damage regularly and replaced when they show signs of unsafe condition. Chains which are still used for certain kinds of lifts require periodic inspection and annealing.

Crane operators must be in good physical condition, alert, have a thorough knowledge of shop sequence, understand and recognize only hand signals, disregarding all signals given orally because of the extreme danger to life and property, caused by misinterpretation of signals. Carrying material over workmen is strictly prohibited, and a warning gong is provided for the use of the crane operator.

Handling Material for Steam Locomotives

Driving tires are cumbersome, weigh up to 1,700 lb. each on large passenger power, and constitute one of the greatest safety hazards in material handling. When carried horizontally in sets of six or eight they are lifted by means of three-leg bridle slings with hooks attached. For applying a tire to a wheel center a forged lifting adapter which locks over the tire flange is used. After removing hot tires from wheel centers, special care must be used, if they are to be stacked vertically, resting on the flanges, to see that there is no possibility of their skidding down. Hot tires have a greater tendency to skid than cold ones.

Running gear, rods, motion work, and other greasy materials removed from the locomotive in the process of stripping, are placed on lift truck skids having special perforated basket-like bodies, and carried to the lye vats for degreasing after which the load is delivered to the proper departments before the skid is unloaded.

Flues and superheater units are loaded on a rack as they are removed from the boiler. The rack is built especially for the purpose, having arms integral with its uprights to which the lifting cables are attached, and it remains with its load until the flues are re-applied to the boiler.

After unwheeling a locomotive, the wheels are removed from the track by placing a cross-bar with a ring in it, through the spoken section; they are lifted with an overhead crane and then placed on a dolly for transporting to the wheel shop. This practice superseded the dangerous practice of rolling them by hand.

Driving springs weighing 500 or 600 lb. are quickly and easily placed in their proper position on the locomotive by using a length of seamless tubing having a movable attachment for connecting to a crane hook.

Air reservoirs are applied underneath runboards by sing a specially constructed two-fingered hook that will tach to a crane hook. The construction of this hook rovides for securing the reservoir against slipping out idwise or rolling off before releasing, which is not one until after the reservoir bracket straps are securely olted around it. Also, a spring arrangement at the ane hook connection allows for a moderate miscalculaon in judgment of signals to prevent damage to runoard that would otherwise result from lifting the reserbir too high when it is under the runboard.

Lift truck skids have been designed for different asses of material handling. Some are made especially handle certain objects that do not lend themselves adily to conventional form skids.

Heavy material, such as locomotive beds, cylinders, oilers, etc., are transported on flat cars into the shops here they are picked up by overhead cranes.

Material for Diesel Locomotives

The engine and generator unit is applied by means of n overhead crane, using a cross-bar with short cable lings attached at the ends. The cross bar has a fixture ith a movable king pin in the center to adjust for center f gravity, which keeps the unit level and facilitates ligning.

Generators can be handled singly by overhead crane sing four leg slings and rings with clevises attached hich are coupled to our eye-bolts screwed into the enerator housing.

Truck removal for wheel and traction motor work is one by means of power jacks located at sides of car nd under the jacking lugs. Safety blocking is used at he ends to protect workmen against a possible jack failre. After this is done, the drop table under the truck s lowered and moved clear.

Traction motors are removed from trucks by means f an overhead crane. The crane is also used to manipuate the motors into position for easy removal of bearing aps, wheel removal, and inspection. Lift trucks are sed to transport motor and wheel assemblies to the roper department. Overhead cranes with rope slings andle parts through the service door.

On switching power on which the doors open on the side, cylinder heads are removed by crane and a lever similar to the method described for steam locomotive driving springs.

Safety of operation in maintenance and repairs, whether it be on assembly or getting material to the point wanted, is an important factor today. Accident prevention has priority over all operations, and safety recommendations are encouraged from the rank and file. Material on the job when needed is what every supervisor desires. To do this, all safety precautions must be adhered to and prevent what we all detest—Accidents.

The Foreman's Responsibility in Accident Prevention

By R. McLean,
Master mechanic, Denver & Rio Grande Western

In any discussion or planning of methods to improve the safety record in shops where a large number of men and women are employed the responsibility of the departmental foremen and the part they are to take in preventing personal injuries must be given first consideration. We expect the foreman to plan his work and distribute it among the employees in his department so the maximum results can be obtained at minimum cost. The mechanics in his department look to him for leadership in outlining their duties, inspection and criticism of their work. They respect him if he is tolerant but insistent on proper workmanship, but if he is careless in this respect his attitude soon affects the morale of everyone under his supervision.

If we are to get efficient supervision in matters pertaining to quantity and quality of work we must also have efficient supervision to see that the work is carried on safely. To get maximum results demands the coordination of both these efforts. Too many foremen have an eagerness only to meet their schedule—and often the schedule is interrupted and delayed due to their lack of eagerness to include safe methods in their supervision and this attitude also has an adverse effect on the morale of employees under his supervision.

Therefore, the duties of a foreman embrace the responsibility of planning safe methods of performing the

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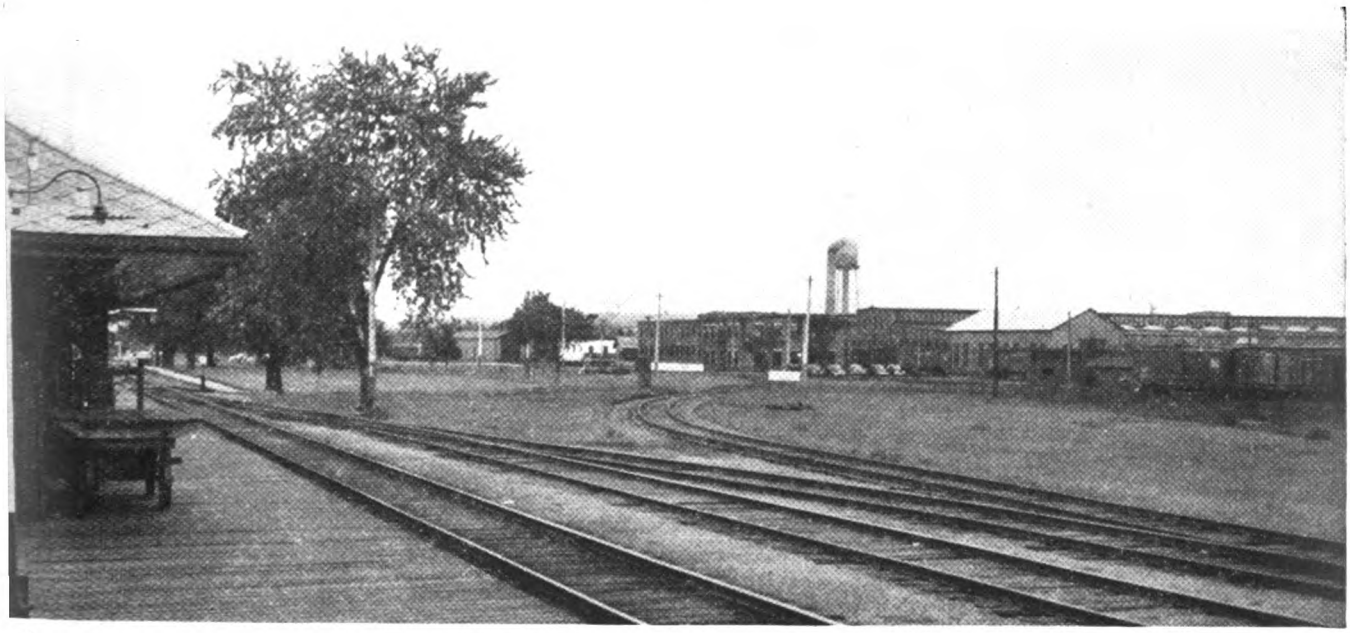

work in his department and personally seeing to it that the safe method is used. To bring this about the foreman, unless he has a natural talent for safety work and willingness to practice it, must be imbued with the ideals of safety by his superior officer. The foreman's procedure in the promotion of safety should include talking to each new employee individually about the work they are to perform, reveal the known hazards and outline the method that from experience has been found to be the safest method. He should make it a point to know that each new employee in his department is furnished with a book of safety rules and instruct him or her to read it and study it. I believe the impression thus made is invaluable in his future contact with the employee. After the employee has been started along the right line it is the duty of the foreman to follow up; that is, when checking on the quality of his work he should also check on how safe he is performing his work.

It is assumed, of course, that the foreman already has the older employees lined up and working safely. If there are any objectors he has the authority to enforce the safety rules and should do so without respect to persons or length of service. Of course, obedience to safety rules in the performance of work should be brought about in a spirit of helpfulness and co-operation to the fullest possible extent but experience shows that certain types violently object to any kind of safety suggestion and it is the duty of the foreman to handle these cases and convert them—he must not shirk this duty or his entire safety program will collapse.

One of the most effective methods of keeping safety alive and an active subject is to hold group discussions. Every foreman should get his employees together at least once a week and conduct a brief departmental safety meeting and let the employees make suggestions and discuss unsafe practices and other conditions that might prevail in the department. During these meetings is the ideal time to get careless and reluctant employees lined up.

Good housekeeping is important and essential to a good safety record. Foremen should see that material in their departments is kept in safe condition and a location where it will not present a hazard to employees moving about in the department, that floors are kept clean to avoid falls from slipping or stumbling.

If it is not company policy to insist on employees wearing safety shoes the foreman should encourage those under his supervision to purchase and wear this type shoe.

If one of his employees is injured, the foreman first of all should see that the injured party receives the proper first-aid attention and is then taken to the doctor or the hospital if the injury is of a serious nature and requires further attention. After this is done the foreman should immediately investigate the location of the accident, the machinery or tools involved, talk to all witnesses and get all the facts pertaining to how the accident happened and what could have been done to prevent it. As soon as possible after the accident, or when the injured party returns to work, these facts should be presented to him and discussed in the presence of one or more members of the shop safety committee from his department. Any carelessness on the part of the injured employee should be called to his attention—or if the accident was due to lack of knowledge on the part of the injured employee he should be informed as to proper handling as a means of preventing recurrence. The facts developed from this procedure should be presented to all employees in the department at the weekly safety meeting to give them the benefit of this one man's experience.

The foreman can and should pass some of this responsibility on to his safety committee but must not lose sight of the fact that he, as the supervisor of the department, is directly responsible for conditions in that department. It is the attention he gives or does not give to safety matters that is going to bring about either a good or a poor safety record.

E. A. Greame,
Chairman

The Influence of Modern Cutting Tools

Carbides have demonstrated how to cut production time and increase tool life—Old machines not too well adapted to their use

During the years 1944 and the first half of 1945 the railroads of the United States went into the market for machine tools in greater quantities than at any time in the past 20 years. The experience, during the war years, of trying to keep up with the ever-increasing demand for production of locomotive repair parts taxed the older machine tool equipment of the average shop to its very limit of capacity and demonstrated the need not only for machine tool units of greater capacity but of machine tools that are designed to take advantage of the many new developments in modern cutting tools.

This committee, in 1941, embarked on a program of recording the progress of the use of modern cutting tools in its report on this subject in that year and there was every indication that the railroads were taking advantage to the limit of their ability, of these new developments as opportunity afforded. In successive years the committee has followed up the investigation and reports have been presented recording the progress that has been made.

Realizing that the removal of some of the wartime restrictions that had made the procurement of new machine tools and tooling equipment difficult were actually being reflected in considerable activity in the field of shop equipment it was believed that this year's questionnaire should be productive of more comprehensive data than had been previously received for inclusion in this report. With that thought in mind questionnaires were directed to the

Machine Operation Data—Locomotive Parts

Name of part ol and material	Machine tool data: Capacity; make; type	Age, yrs.	Motor, hp.	Machine condition	Description of operation	With cutting tools formerly used: Tool used	Speed, f.p.m.	Feed, in.	Time per piece, h.m.s.	No. pcs. per tool grind	With cutting tools now used: Tool used	Speed, f.p.m.	Feed, in.	Time per piece, h.m.s.	No. pcs. per tool grind
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Engine truck tire—24-in. bore	50-in. Bullard vertical turret lathe	23	15	Fair	Bore	High-speed steel	12	.018	2-39-00	½	Kennametal	38	.018	1-12-00	1
Exhaust nozzle, cast iron	50-in. Bullard vertical turret lathe	23	15	Fair	Face	High-speed steel	17	.011	0-49-00	6	Kennametal	54	.011	0-18-00	6
Driving box brass	48-in. Bullard vertical turret lathe	16	20	Good	Bore	High-speed steel	150	.040	0-45-0	5	Carboloy	250	.040	0-25-00	96
Cylinder bushing, cast iron	54-in. Bullard vertical turret lathe	16	15	Good	Turn, bore	High-speed steel	8 r.p.m.	.125	12-0-0	1	Carboloy	12 r.p.m.	.125	8-0-0	10
Rod bushing, gun iron	24-in. Bullard vertical turret lathe	1	15	Good	Turn, bore, face	Stellite	68	.027	2-10-0	1	Carboloy	156	.027	0-58-0	4
Rod bushing, bronze	24-in. Bullard vertical turret lathe	1	15	Good	Turn, bore, cut-off	Stellite	190	.062	1-30-0	6	Carboloy	450	.032	0-40-0	15
Bronze pin, 1¾ in. x 5 in.	2½-in. Gisholt turret lathe	3	10	Good	Turn, cut-off	Rex AA	152 r.p.m.	.011	0-4-15	50	Kennametal	500 r.p.m.	.016	0-2-0	200
Driving tire, 72 in.	96-in. King boring mill	20	25	Good	Bore	High-speed steel	76	.015	2-0-0	1	Vascoloy	160	.015	0-58-0	20
Motion bushing	14-in. Monarch engine lathe	7	—	Good	Rough	Cobalt	160	.015	0-1-50	2	Vascoloy	280	.015	0-0-50	40
					Finish	Cobalt	160	.015	0-1-50	2	Vascoloy	280	.015	0-0-50	40
Floating rod bushing	24-in. Bullard vertical turret lathe	25	7½	Fair	Rough	Stellite	180	.028	0-3-20	1	Vascoloy	250	.028	0-2-15	40
					Finish	Stellite	180	.014	0-6-35	1	Vascoloy	250	.014	0-4-45	40

tention of individuals who are members of the association on a total of 29 railroads, 17 of which are eastern ilroads and 12 western roads. The returns from this uestionnaire were disappointing, particularly from the estern roads, and the committee can only assume that ie pressure of responsibilities, just prior to the actual id of the war and its immediate after effects, was a ost important factor in the lack of data furnished. That rnished by the few roads that replied is tabulated in ie accompanying table and shows some of the comparave performances on several important locomotive maining operations.

There are three general observations that may be made rom the limited amount of data shown in the table. First, comparison of the performance between the new mahines that are shown and some of the older machines that re still in service emphasizes the important fact that uch higher cutting speeds can be used and, as a result, ie production time can be lowered. Second, that the lder machines do not have the capacity—in most cases ue to inherent design—to utilize modern cutting tools to ieir utmost and that, at best, on many old machines a ompromise must be made. This compromise is usually ade because the older machine either does not have the ower or the speed range to perform with new cutting ols in accordance with the recommendation of the anufacturer. Third, one of the major advantages of ost of the modern cutting tools is tool life—the number f pieces between tool grindings. Many of these new utting tools have inherent characteristics which depend pon operation at certain speeds in order to obtain the esired finish of the machined parts and to obtain the ool life that should be expected. When these tools are sed on many of the older machines, which, in some ases, do not have sufficiently high top speeds, both finish nd tool life must be sacrificed to some degree.

There is one other observation that may be appropriate n a report on this subject. Due to a variety of conditions, some of which are directly related to the ability of nachine operators and the supervision over machine operators, many of the new machines that have been installed n railroad shops within the past year are not being utilzed to their capacity. In most cases it can be assumed hat in requesting the authority to purchase a new mahine the shop tool committee estimated the savings to be xpected on the basis of the production performance vhich the manufacturer guaranteed for the machine. If very effort is not made to follow the recommendations of the manufacturer both as to tooling equipment and methods as well as to the actual operation of the machine the expected economies will not be forthcoming.

A case in point which was recently observed was in connection with the production of tapered bolts on a turret lathe installed in a shop at a cost of over $20,000. This machine was turning out a 1⅝-in. by 8-in. taper bolt in slightly over four minutes per bolt (not including the threading operation). The factory demonstrator, on this same machine, was able by proper tooling and proper operation of the machine to produce bolt after bolt in less than 90 sec. and because of the proper tools and speeds these botls were far superior in finish and accuracy of size. In addition, the life of the tools was over twice as many pieces per tool grind.

The members of the committee were E. A. Greame (Chairman), tool foreman, D. L. & W.; Wallace Brown, shop supervisor, B. & M.; Wm. Leys, general machine foreman, G. T. W.; J. I. Stewart, supervisor shop machinery and tools, N. Y. C., and H. C. Wilcox, associate editor, *Railway Mechanical Engineer*.

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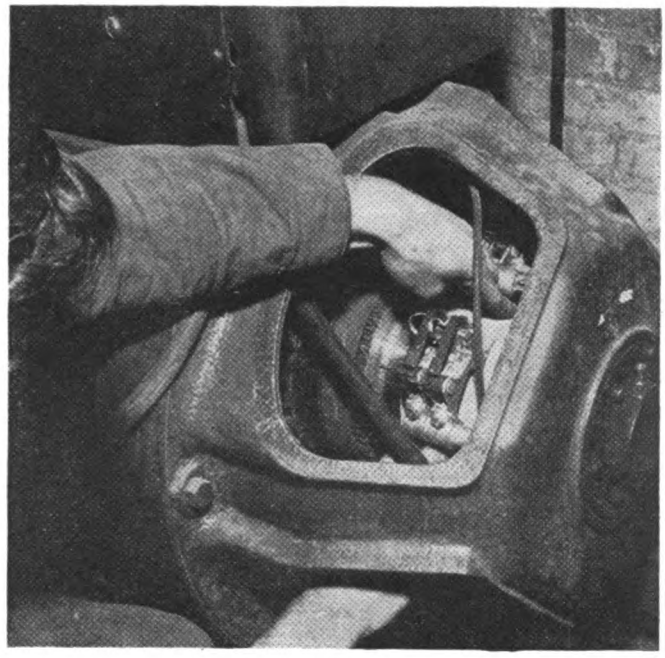
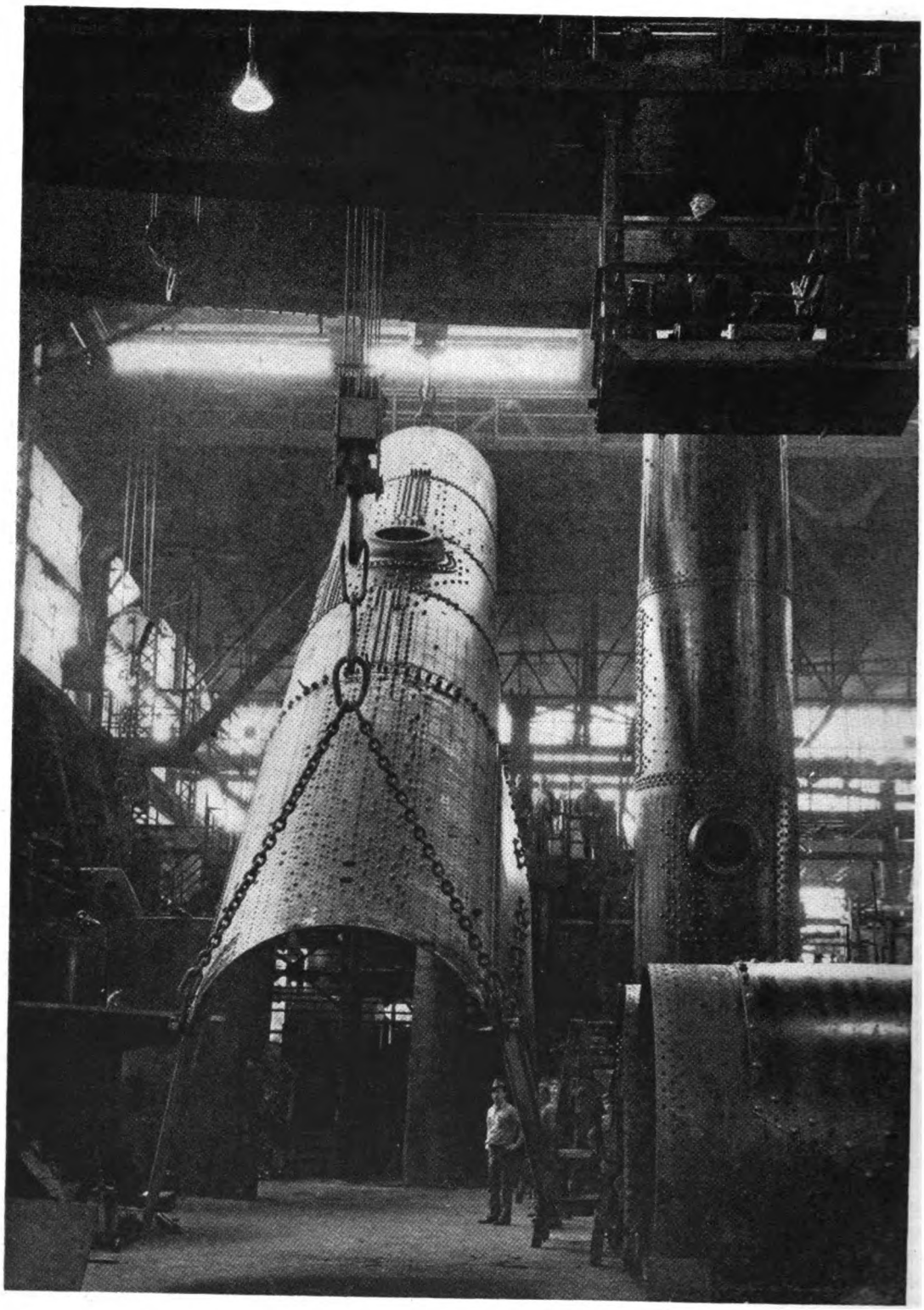




The Master Boiler Makers' Association

Five committees active in 1945 and submit reports — Interest in all-welded boilers continues

Five committees of the Master Boiler Makers' Association have continued their studies of matters of interest to the Association's membership during the past year, the fourth in which no member meeting could be held. There is space in this issue for the presentation of only one of the reports, the others will be published later in either complete or abstracted form. All will be published in their entirety in the 1945 year book of the Association. The committees dealt with the construction of locomotive boilers of the all-welded type; the treatment of boiler feedwater; cinder cutting; application of staybolts, and the application and maintenance of flues and tubes. The report on all-welded boilers published here presents a comprehensive review of the developments in this field which have so far taken place. It then sets forth complete specifications for the construction of welded boilers as they are now to be built.

The officers who served during 1945 will continue in office for the coming year. They are: President, Myron C. France, general boiler foreman, C. St. P. M. & O.; vice-president, Frank A. Longo, general boiler inspector, Sou. Pac.; secretary-treasurer, A. F. Stiglmeier, general supervisor boilers and welding, N. Y. C. Members of the Executive Board who will continue to serve are Frank A. Longo (chairman), general boiler inspector, S. P.; Frank Yochem (secretary), general boiler inspector, Mo. Pac.; W. H. Keiler, I. C. C. locomotive inspector, Bureau of Locomotive Inspection, Interstate Commerce Commission; E. E. Owens, general boiler inspector, U. P.; B. C. King, general boiler inspector, No. Pac.; Edward H. Heidel, general boiler foreman, C. M. St. P. & P.; R. W. Barrett, chief general boiler inspector, Can. Nat'l.; Sigurd Christopherson, supervisor boiler inspector and maintenance, N. Y. N. H. & H. and E. H. Gilley, general boiler foreman, Grand Trunk. The members of the Advisory Board, who will also continue to serve are: E. R. Battley, chief of motive power and car equipment, Can. Nat'l.; B. M. Brown, general superintendent of motive power, Sou. Pac.; E. L. Grimm, general mechanical superintendent, Nor. Pac.; F. K. Mitchell, assistant general superintendent of motive power and rolling stock, N. Y. C., and H. H. Urbach, mechanical assistant to vice-president, C. B. & Q.

More All-Welded Boilers to Be Built

Approval obtained by roads in United States and Canada to construct four welded boilers— Standard procedural specifications are set up

E. H. Heidel, Chairman

The committee appointed to report on Topic No. 1 "Proposed Planning and Fabrication of Postwar Locomotive Boilers With X-Ray Development," has endeavored to obtain information on the subject from many and widespread sources for use in compiling its report containing recommendations for postwar locomotive boilers, in particular those of the all-welded type.

The planning and fabrication of postwar locomotive boilers should and must be given attention in these days, when there is so much discussion about lightweight, high-speed and higher-pressure locomotive boilers. Planning will depend upon the requirements. If we are to think of a boiler that must compete with other sources of power, we must consider the steam locomotive as a whole and its comparison with other types of power. It is improbable that any one design of boiler will meet all needs but the postwar boiler should embody all of the proven advances in design, materials, construction and practices which are best adapted to use in meeting the service requirements.

The D. & H. Welded Boiler

There is no question but that much study has been given the all-welded locomotive boiler by the railroads and the locomotive builders since the year of 1937 when the all-welded boiler was discussed at our annual meeting, and published on pages 91 to 94 and 98 to 99 inclusive of our 1937 annual proceedings covering the

all-welded locomotive boiler built by the American Locomotive Company for the Delaware & Hudson.*

Your committee feels that no report on this all-welded boiler would be complete without progress and data information, and G. S. Edmonds, superintendent of motive power, D. & H., has again cooperated with the committee in furnishing this information to August 31, 1945.

(Mr. Edmonds' report detailed the early history of the boiler while it was used as a stationary boiler in accordance with the requirement made by the Bureau of Locomotive Inspection when authority for construction was issued. After the boiler was put into locomotive service it received quarterly inspections with the jacket and lagging removed. Test pressure of 225 lb. was applied for the first three of these inspections. No leaks were found. The next two inspections were made with 340 lb. pressure, and the succeeding two with 350 lb. pressure. No leaks were found. In July, 1941, during the boiler's fourth year in service and in July, 1942, during its fifth year, the boiler was carefully examined and tested and the welding of the shell, wrapper and firebox sheets found to be in good condition. There were no leaks.

In July, 1943, the D. & H. was notified by the Bureau of Locomotive Inspection, "With reference to hydrostatic test to be applied to boiler of locomotive No. 1219, will advise that in the future, compliance with Rule 17 will be satisfactory; that is, hydrostatic test 25 per cent above working pressure." In August, 1943, the locomotive received classified repairs at the Colonie shops at which time firebox throat and flue sheets were applied at a mileage of 304,000. A check of 17 other locomotives of the same class showed an average life for these sheets of 193,000 in conventional riveted boilers. As of August 31, 1945, the locomotive had made 381,000 miles without any boiler trouble.—EDITOR.)

Because of the successful performance obtained from the D. & H.'s all-welded locomotive boiler, the Master Boiler Makers' Association selected, in the year 1944-1945, a committee to give study to the fabrication of postwar locomotive boilers, particularly of the all-welded type. They had already given similar attention to riveted construction in the past. In the year 1944 this committee reported an all-welded and semi-welded locomotive boilers. This report is published on pages 40 to 62, inclusive, of our 1944 proceedings.†

* See *Railway Mechanical Engineer*, October 1937 p. 501 for the text of this report which describes the construction details of the boiler.

A Builder Speaks

In a paper presented by James Partington, manager, engineering department, American Locomotive Company, at the March 19, 1945, meeting of the Northwest Locomotive Association, St. Paul, Minn., he said, "Railroads themselves must become proponents of welded boilers before this type of construction can become, I will not say standard, but even generally accepted."

"The Interstate Commerce Commission has cooperated with the railroads in the development of welded boilers and followed closely the service of the experimental welded boiler on the D. & H.

"The Bureau of Locomotive Inspection is fully conversant with the construction details and has complete information on the test requirements that have to be met in the building of welded locomotive boilers.

"We know that they will give careful and prompt consideration to all requests for permission to install and operate such boilers on locomotives which come under their jurisdiction.

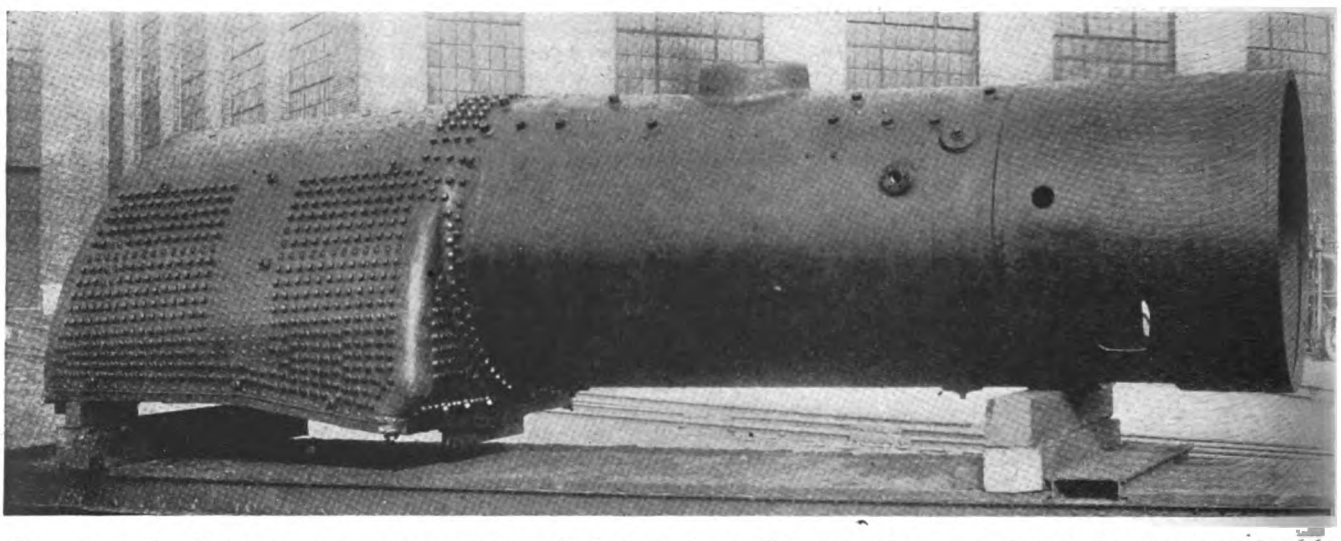
"Electric arc welding, gas welding and forge welding were in use to a partial extent in the construction of new locomotives and repair of locomotives that were in service in the early part of the 1910 decade.

"On new work butt welds in locomotive fireboxes were made first with oxy-acetylene and later by electric-arc welding, using bare wire electrodes. The methods were used when maintenance in service required the application of patches in locomotive fireboxes. All of these welds were in the staybolted areas of the firebox and usually gave satisfactory results, the welds being supported by other means. In some railroad shops repairs were made to the shell portion of locomotive boilers by electric arc welding, the welds being made from the outside only.

"These welds were not stress-relieved, and would not meet the test requirements of present-day codes, nor the procedure rules of the American Welding Society. They were generally unsatisfactory, new cracks soon developed when the locomotives were put back into service.

"This was not the only kind of repairing which was done by electric arc welding. It was used extensively as a repair tool, sometimes with undesirable results. The

† See *Railway Mechanical Engineer*, November 1944, page 490.



The original all-welded boiler as it was received from the builder's shop in 1937—It has been in locomotive service since September of that year and has given complete satisfaction

F. A. Longo

Myron C. France

A. F. Stiglmeier

Officers
Master Boiler Makers' Association
1944-45

President: *Myron C. France, general boiler foreman, Chicago, St. Paul, Minneapolis & Omaha, St. Paul, Minn.*

Vice-President: *F. A. Longo, general boiler inspector, Southern Pacific, San Francisco, Calif.*

Secretary-Treasurer: *A. F. Stiglmeier, general supervisor boilers and welding, New York Central System, New York.*

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E. R. Battley, chief of motive power and car equipment, Canadian National, Montreal, Que.

B. M. Brown, general superintendent motive power, Southern Pacific, San Francisco, Calif.

E. L. Grimm, general mechanical superintendent, Northern Pacific, St. Paul, Minn.

F. K. Mitchell, assistant general superintendent motive power and rolling stock, New York Central System, New York.

H. H. Urbach, mechanical assistant to executive vice-president, Chicago, Burlington & Quincy, Chicago.

E. R. Battley

B. M. Brown

E. L. Grimm

F. K. Mitchell

H. H. Urbach

use of this welding on boiler shells gave results which were not what might have been hoped for.

"These conditions caused the Bureau of Locomotive Inspection of the Interstate Commerce Commission to issue orders prohibiting all welding on the pressure parts of locomotive boilers and only permitting welding in the fireboxes as above outlined, with the provision that no firebox welds would be allowed higher than 14 in. below the top of the crown sheet.

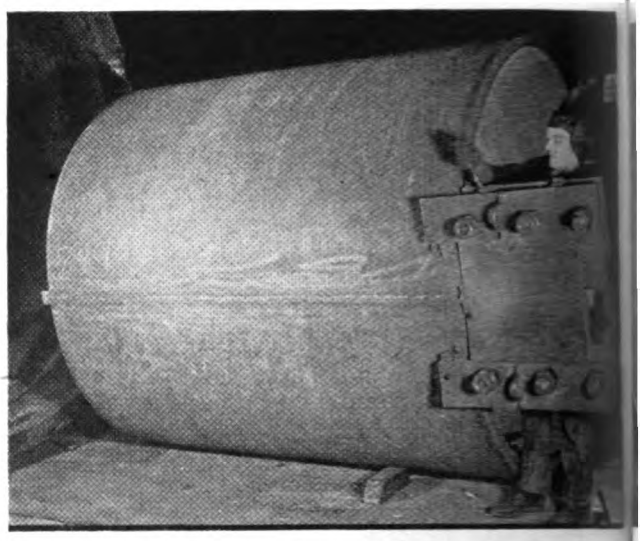
Development of Welded Boiler Code

"The increasing use of welded construction in boilers and pressure vessels was noted with interest by the Boiler Code Committee of the A. S. M. E., and it was further emphasized when a request was received early in 1918 from the National Welding Council, which later merged with the American Welding Society, for affiliation with the A. S. M. E. in making a study of the subject. At its meeting on March 28, 1918, the Boiler Code Committee appointed a sub-committee on welding to draft rules for safe welding practice. In doing that, the usual practice of the committee was followed.

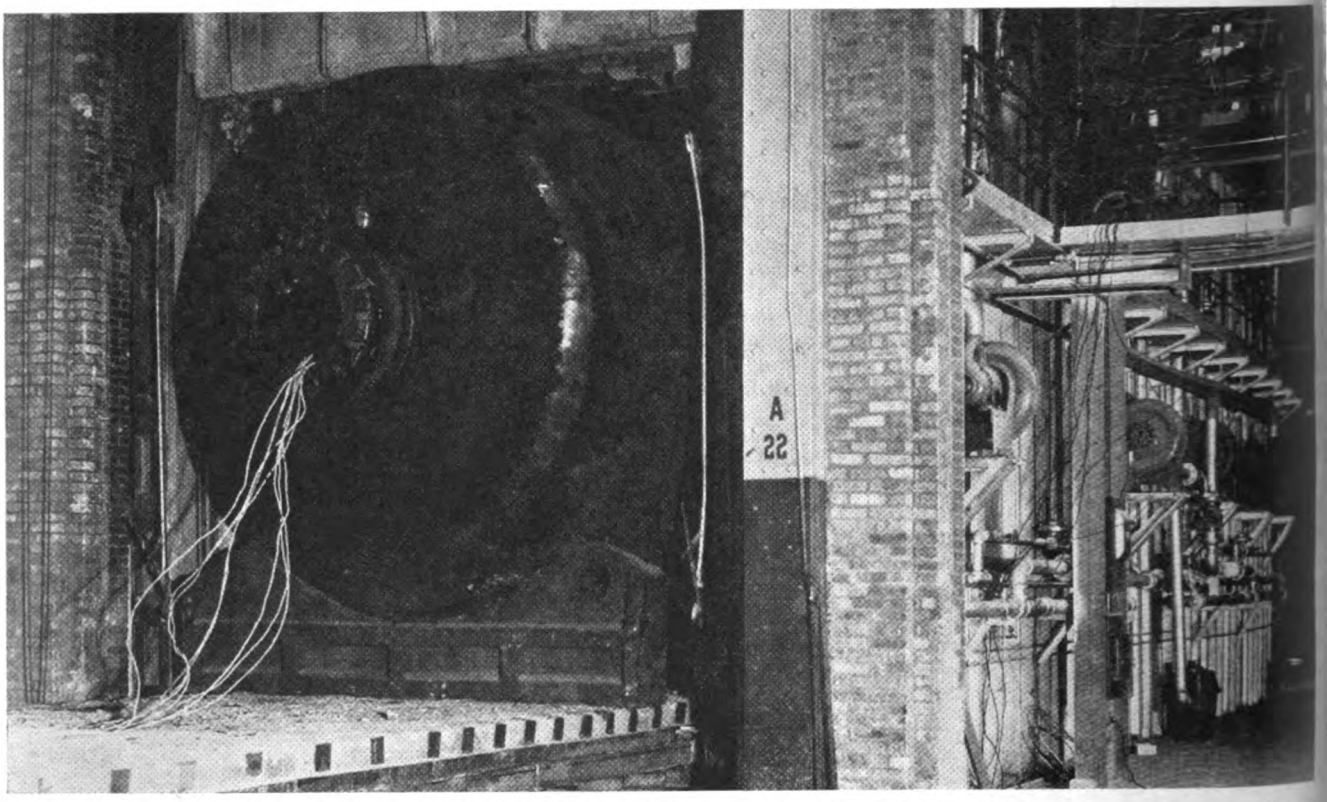
"The members of this committee represented a reasonably complete cross-section of the welding industry, i. e., electric arc welding, gas welding, and forge welding as used in railroad, power plant, gas storage, and refrigeration equipment.

"In January, 1920, the Boiler Code Committee requested the American Welding Society, which had been organized early in 1919, to appoint a conference committee to work with the Boiler Code Subcommittee in drafting a set of welding rules. This proved to be a difficult task which required four to five years of intensive effort by the two committees.

"The welding code was finally adopted and first issued for use in the first edition, 1925, of the Code for Unfired Pressure Vessels. The welding code rules were added to the code for power boilers in 1931 and in the code for boilers of locomotives in 1942. This welding code and the American Welding Society rules for the qualification of welding procedure and the qualification of welders have been most helpful in pointing the way for the very marked improvement that has taken place in all kinds of welding and in all types of welded construction.



Weld test plates are attached to shells

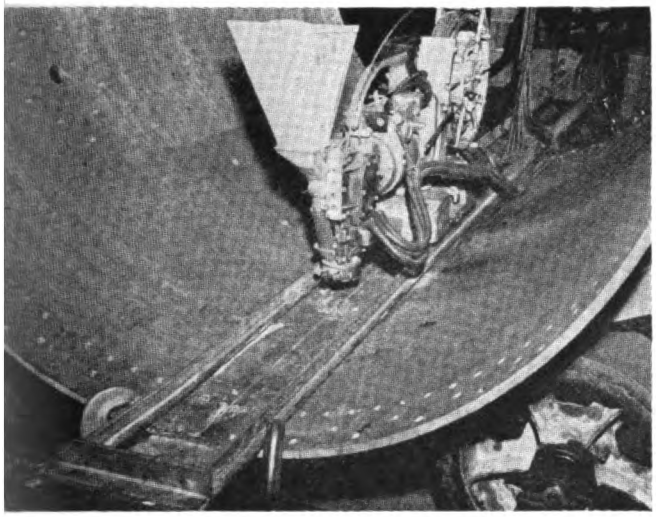


Stress relieving in furnaces large enough to accommodate the entire boiler is an absolute essential—The photograph shows an all-welded pressure vessel in such a furnace

"From the request by the Mechanical Committee of the A. A. R. it was evident that some railroads were getting to a point where they wanted to have welded boilers and wanted the rules in the code for locomotive boilers.

"These codes are written on the basic requirements of definite test results and this method has proved satisfac-

ry and adequate for all types of welding. The early scussions of the committee which was given the job drafting the rules showed that those rules would ve to be as devoid of procedure qualifications as pos-



Submerged-melt welding assures a uniformly good weld if procedures are correct and fit-up good

sible because the different types of welding in use at that time had proponents who were particularly enthusiastic about their type of welding and not enthusiastic about other types. For instance, forge welding was in use, had been recognized by the Boiler Code Committee and given a moderate value. They claimed their method as 100 per cent. Electric arc welding also claimed 100 per cent. Gas welding people knew their welding was 100 per cent. So the committee came to the conclusion that the only way rules could be drawn was to base those rules on required test results. That is the way the code was written, that is the way it stands now. It is a method that covers the situation and has general approval.

Railroads' First Welded Boiler

"In the railroad field one of the results of this progress in welding was the building of a welded boiler for a locomotive. The Bureau of Locomotive inspection of the Interstate Commerce Commission permitted the application and use of one completely welded boiler on a Consolidation-type freight locomotive of the D. & H.

"This boiler was built in accordance with the rules of the A. S. M. E. boiler code for power boilers, and the design and construction procedure were approved by the Mechanical Division of the A. A. R., the code of power boilers being taken because there were then no code rules for the welding of locomotive boilers in Section 3 of the code. This boiler has been in successful operation on the D. & H. for nearly seven years. By successful operation I mean that no flaws, cracks, leaks, or any imperfections of any kind have developed in the welded seams, and the parent metal of the boiler has not developed any cracks, so the boiler has required no repairs, no riveted patches, and still stands today a 100 per cent example of a welded boiler in service doing the job without any repairs being necessary.

"Before this boiler was installed on a locomotive for road service, the I. C. C. stipulated that it should be set up as a stationary boiler and operated for six weeks. That was done. Then it was mounted on a locomotive and examined every three months for the first year. All the welded seams were carefully gone over. The second year the same procedure was followed every six months. And subsequent to that, the boiler has been examined yearly. It has been 100 per cent clear of any leaks.

Welded Boiler Advantages

"No additional completely welded boilers for locomotives have yet been built but a number of railroads at the present time wish to put welded boilers in service. Some of the advantages to be gained by the use of welded boilers for locomotives are:

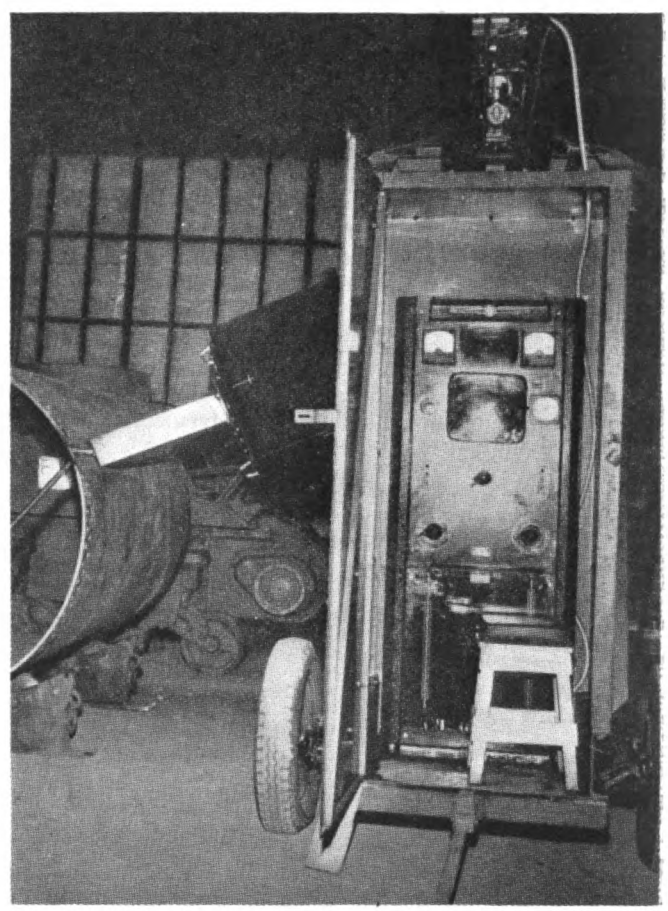
"1. The elimination of riveted joints which are likely to have some seepage between the boiler plates even when the best possible fabricating technique is employed.

"2. Elimination of boiler leaks, removing the possibility of cracked sheets which are frequently a major item of maintenance cost especially when high boiler pressures and high operating speeds are involved.

"3. The smooth contour of a welded boiler permits a much easier and an all-'round more satisfactory application of the boiler lagging and jacket, and provides the same smooth surface on the inside which contributes to easier and more satisfactory washouts.

"4. On many modern locomotives the saving in weight of the welded design versus the riveted job is an important item. This saving will vary with the size and type of locomotive and may be from 3,000 lb. to 6,000 lb. for a boiler alone with some small incidental additional saving in weight of lagging and jacket.

"5. The saving in maintenance costs with a welded boiler is likely to be an important item. Take for example the D. & H. boiler which has been in service six and a half years with no shell repairs.



All strength welds must be X-rayed

"You are no doubt questioning how practically 100

per cent welding is attained. The necessary steps to obtain this result are generally:

"1. The qualification of the shop welding technique, apparatus, electrodes, plate material, etc., by the production of the test specimens that meet the code requirements for Welding Procedure. These specimens must meet the tests for tensile strength, elongation, soundness of the weld metal, etc.

"2. The qualification of the welding operators using the welding procedure that has been approved. These tests are specially devised to determine the operator's ability to produce sound welds in the positions involved in the actual welding of the boiler. This is the groundwork or preparation carried out before the job is started. Test specimens must be furnished for each boiler and these specimens must meet all of the requirements.

"3. All of the strength welds must be X-rayed and must show the required degrees of soundness, freedom from inclusions or porosity.

"4. After the welded boiler has passed the X-ray examination successfully it is stress-relieved in a furnace of sufficient size to take the boiler as a unit. This furnace must be under pyrometer control and must show a closely uniform temperature at all points. The test specimens are subjected to the same heat treatment, preferably with the boiler.

"5. After the firebox has been applied and the boiler completed, a hydrostatic test pressure of one and a half times the working pressure is applied and under this pressure all of the welds are subjected to a hammer test.

"In the fabrication of a welded boiler nothing is left to chance, all of the code rules are carefully followed and the result obtained can reasonably be expected to be approximately 100 per cent. In the manufacture of a welded boiler the welding process must be the proper one for the material being welded. Alloy steel requires a different procedure from that employed in welding ordinary carbon steel boiler plate of 55,000 lb. tensile strength. High-carbon, high-tensile steel also requires a different procedure.

"In the fabrication of the D. & H. welded locomotive boiler there were several interesting design features. The attachment of the front tube sheet is one. This is designed for easy removal if a new tube sheet should be needed during the life of the boiler. The attachment of the dome of this boiler was a very special construction.

"Since the welding codes were issued the amount of welded construction has increased tremendously and greatly improved welding is the rule rather than the exception. In the earlier stages of welding, hand welding prevailed generally throughout the industry. Today, machine welding is very extensively used.

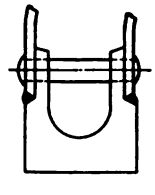
215 Partially-Welded Boilers

"The American Locomotive Company on one order recently produced 100 boilers with the barrel courses welded longitudinally instead of a riveted joint with inside and outside welt straps. These longitudinal joints were machine welded by the submerged process, then X-rayed and stress relieved. Extremely little cutting out of weld material was required. We have since supplemented that program with another 115 locomotives on which the barrel courses have the longitudinal seam welded and no inside and outside weld straps. A recent report from our welding supervisor was that on nineteen sets of boiler courses just welded no cutting out was necessary.

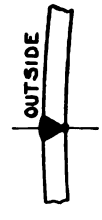
"Cutting out is required when the X-ray shows any flaws or inclusions that are of sufficient amount to make replacement necessary to meet code rules. In the locomotive code up to this time, the value assigned to a joint is 90 per cent. In the power code, they have increased that value to 95 per cent. This is allowable and safe because the quality of welding since the codes were first issued has improved wonderfully and the efficiency and accuracy of the X-ray examinations also have been wonderfully improved. There is a technique laid down for taking the X-ray picture which has gradually developed as the X-ray machines came more and more into practical use, so that today the X-ray of steel plate has become much more nearly an exact science, those who do the job and those who are employed in reading the pictures being specially trained for this work.

"The machine welding removes the human element encountered in hand welding, and if the procedure is correct a uniformly good weld is assured, provided the fitting up is all that it should be. In machine welding the fitting up of the job is a matter of utmost importance. Running a machine at 10 or 12 in. per min., the machine has no ability to judge whether there is a little more space between the sheets than is desired while in hand welding the feel of the job permits the operator to adjust such things. In machine welding the fitting up should be uniform throughout. If you have too much of an aperture you will burn through and have to cut out and re-weld.

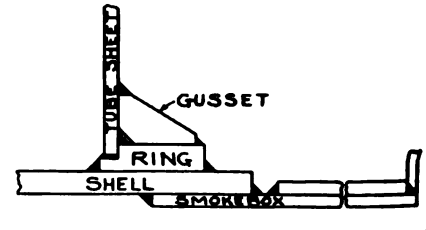
"In fabricating several hundred shell courses of locomotive boilers with welded seams we have put the shop on a satisfactory production basis, but I do not think the locomotive builders are going to dispose of their bull riveters. I do think there are going to be a considerable number of welded boilers built for our railroads in the next few years, and that the welded boiler is going to be a very definite item in railroad service, coming into the picture gradually. I think it will solve a number of present-day railroad problems. Of the several hundred boilers referred to as having welded shell courses, the longitudinal seams only are welded, the courses being put together with circular seams of the usual riveted construction."



FIREBOX RING TO BACKHEAD AND FIREBOX BACK



LONGITUDINAL WELD



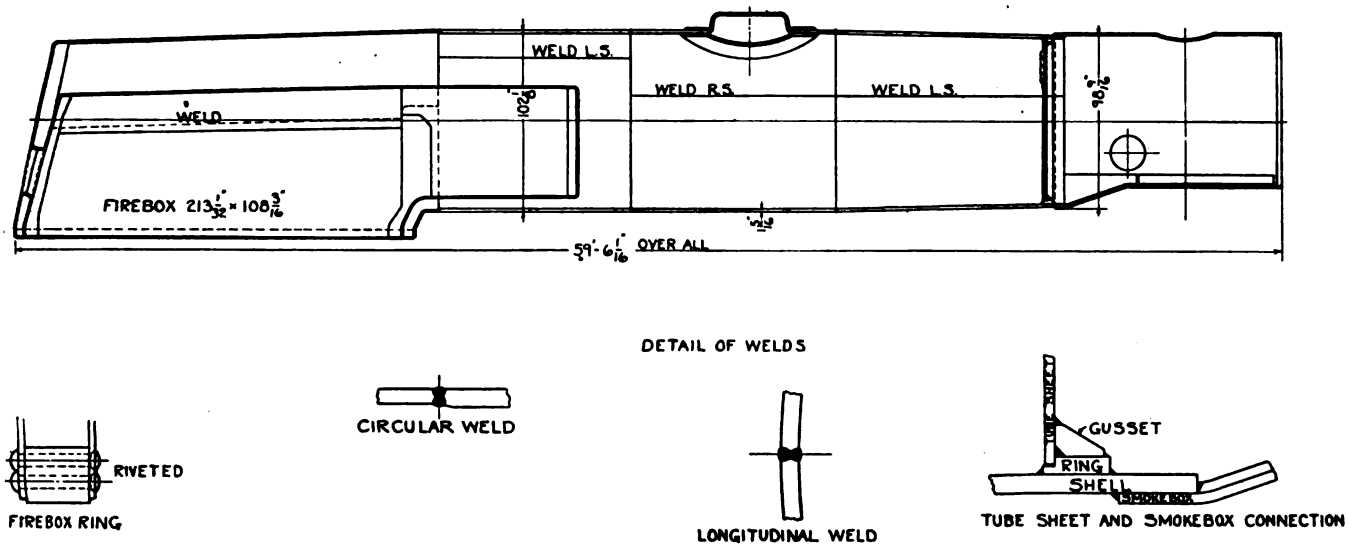
TUBE SHEET AND SMOKEBOX CONNECTION

Connection details used in first all-welded D. & H. boiler

Government Agencies Approve More Welded Boilers

During the past year the railroads with the cooperation of the locomotive builders have designed an all-welded

locomotive boiler, following the A. S. M. E. code for locomotives, which was approved by the Mechanical Division of the Association of American Railroads prior to being presented to the Bureau of Locomotive Inspection, Interstate Commerce Commission and the Transport Commissioners for Canada for approval. Since the publishing of our 1944 Annual Proceedings, approval



Outline drawing of all-welded boiler to be built for application to a D. & H. 4-6-6-4 locomotive—Connection details are also shown

has been obtained from the Interstate Commerce and the Transport Commissioners of Canada for the construction of all-welded locomotive boilers as follows:

One for the D. & H. 4-6-6-4 type locomotive. This boiler has three barrel courses, the largest being 102⅛-in. o. d. with a shell thickness of 1 5/16 in. The overall length is 59 ft. 6 in.; working pressure, 285 lb.

One boiler for the New York Central, 4-6-4 type to replace a riveted-type boiler on a locomotive now in service. This boiler has three barrel courses, the largest being 92 1/16 in. o. d. with a shell thickness of 1 5/32 in. The overall length of this boiler is 44 ft.; working pressure, 275 lb.

Two boilers for the Canadian Pacific for 4-6-2 type locomotives. These boilers have three barrel courses, the largest being 75 13/16 in. o. d. with a shell thickness of 27/32 in. The overall length is 35 ft. ⅞ in. and the working pressure is 250 lb. These boilers are to be built by the American Locomotive Company.

Welding Closely Controlled

All of these boilers will be built to specifications covering construction which are approximately as given here.

Specifications Covering Construction of a Locomotive Boiler Having Fusion-Welded Boiler Shell

General: (1) This specification covers a boiler having a fusion-welded boiler shell; (2) where construction permits, all butt seams will be double welded; (3) wherever the term inspector is used in this specification, it shall mean the locomotive builders qualified inspector. Further inspection of all work by authorized inspectors of the purchaser, located at the locomotive builder's plant, is permitted; (4) all work will be done in the best and most substantial manner according to the true intent of the drawings and specifications; (5) only mechanics known to possess craftsmanship in accord with the specifications herein set out will be employed on this work; (6) operators who will do the manual welding will be qualified in conformance with requirements of A. S. M. E. code. The builder's automatic welding machine will produce a weld that has proved to be serviceable in steam boilers and has been accepted as such by responsible code authorities; (7) construction and application of all parts, except as specifically mentioned in connection with fusion welding, shall be in accordance with best recognized practice.

Materials: (8) All materials to be of the best quality of the respective kind for the purpose intended and to fully meet the requirements of this specification.

Boiler Shell Welding: (9) The process of welding in the construction of the boiler shell shall conform to the requirements contained herein as to radiographs, stress relieving, etc. The term boiler shell covers the barrel, manhole or dome, front tube sheet, outside throat, roof and sides, and backhead.

Factor of Safety: (10) The factor of safety of any joint made, tested and inspected in conformance with the requirements contained herein, shall be not less than 4½, based on a joint efficiency of 90 per cent of the lowest tensile strength of the plates. The factor of safety of all other parts shall be in conformance with the established laws, rules and instructions for Inspection and Testing of Steam Locomotives and Tenders and their appurtenances, issued by the Interstate Commerce Commission, Bureau of Locomotive Inspection, Transport Commissioners of Canada, and the A. S. M. E. Boiler Code for Welded Locomotive Boilers.

Welding: (11) The welding shall meet the following test requirements: (a) Test plates for longitudinal joints. A test

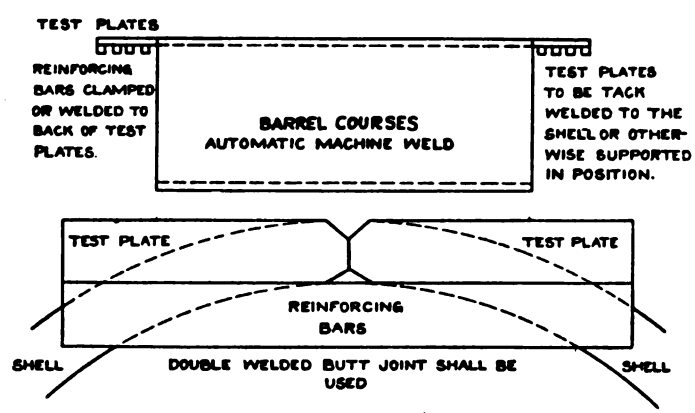


Fig. 1—A method of forming longitudinal test plates

plate of the dimensions shown in Fig. 2 from steel of the same specifications and thickness as the barrel courses, prepared for welding, may be attached to the barrel course being welded, as in Fig. 1, on one end of the longitudinal joint of each course. A test plate of the dimensions shown in Fig. 2 from steel of the same specification and thickness as the wrapper sheet roof and wrapper sheet sides, prepared for welding as in Fig. 1 (2) may be attached to the wrapper sheet being welded, on one end of the longitudinal joint of each wrapper sheet. All test plates

so attached that the edges to be welded in the test plates are a continuation of and duplication of the corresponding edges of the longitudinal joint. In each case the weld metal shall be deposited in the test plates continuously with the weld metal deposited in the longitudinal joint. The plates for test samples

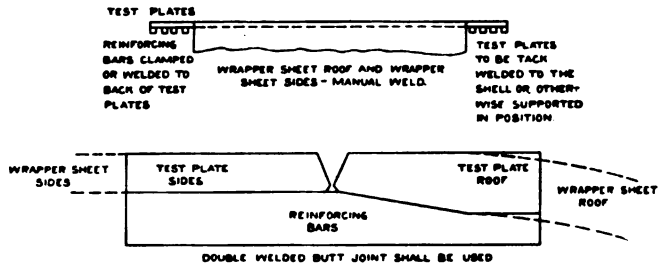


Fig. 1a—A method of forming longitudinal test plates

may be taken from any part of one or more of the same lot of material that is used in the fabrication without reference to the direction of mill rolling.

(b) Test plates for circumferential joints. When test plates are welded for the longitudinal joints, none need be furnished for circumferential joints in the same shell, provided the welding process, procedure and technique are the same.

(c) The test plates shall be so supported that warping due to welding shall not throw the finished test plate out of line by an angle of over 5 deg. Where the welding has warped the test plates, they shall be straightened before being stress relieved. The test plates shall be subjected to the same stress relieving operation, as required by Par. 16 A. S. M. E. code. At no time shall the test plates be heated to a temperature higher than that used for stress relieving the drum or shell.

(d) Test specimen. Coupons for tension and bend test determinations shall be removed from the welded test plate as shown in Figures 2 and 3. The coupons shall conform as nearly as possible to the dimensions shown in the figures.

(e) Tension tests. Two types of tension test specimens are required, one of the joint and the other of the weld metal. The tension specimen of the joint shall be transverse to the welded joint, and shall be the full thickness of the welded plate after the outer and inner surfaces of the weld have been machined to a plane surface flush with the plate.

The tensile strength of the joint specimen in Fig. 2 shall not be less than the minimum of the tensile range of the plate used. (The tension test of the joint specimen as specified herein, is intended as a test of the welded joint and not of the plate. If the specimen breaks in the plate and the weld shows no sign of weakness, the test may be accepted as meeting the requirements.)

The tension test specimen of the weld metal shall be taken entirely from the deposited weld metal and shall meet the following requirements: Tensile strength, at least that of the minimum of the range of the plate which is welded; Elongation, min., 20 per cent in 2 in. For plate thicknesses less than 5/8 in., the all-weld metal tension test may be omitted.

(f) Bend tests. The bend test specimen shall be transverse to the welded joint of the full thickness of the plate and shall be of rectangular cross-section with the width of 1½ times the thickness of the specimen.

The inside and outside surfaces of the weld shall be machined to a plane surface flush with the plate. The edges of this surface shall be rounded to a radius not over 10 per cent of the thickness of the plate. The specimen shall be bent cold under free bending conditions until the least elongation measured within or across approximately the entire weld on the outside fibers of the bend test specimen is 30 per cent.

When a crack is observed in the convex surface of the specimen between the edges, the specimen shall be considered to have failed and the test shall be stopped. Cracks at the corners of the specimen shall not be considered as a failure. The appearance of small defects in the convex surface shall not be considered as a failure if the greatest dimension does not exceed 1/16 in.

(g) Retests. Should any of the tests fail to meet the requirements by more than 10 per cent, no retest shall be allowed except that in the case of failure of the free bend test specimen due to permissible defects, free bend specimen retests may be allowed at the discretion of the inspector.

Should any of the tests fail to meet the requirements by 10 per cent or less, retests shall be allowed. A second test plate shall be welded by the same operator who welded the plate which failed to meet the test requirements. The retest shall be made on specimens cut from the second plate.

The retests shall comply with the requirements. For either of the tension retests, two specimens shall be cut from the second test plate, and both of these shall meet the requirements. When there are more than one specimen of the same type and when one or more of the group specimens fail to meet the requirements by 10 per cent or less, the retest shall be made on an entire group of specimens, which shall meet the requirements.

If the percentage of elongation of any tension test specimen is less than that specified and any part of the fracture is more than ¾ in., from the center of the middle third of the gauge length of the full size specimen as indicated by the scribe scratches marked on the specimen before testing, a retest shall be allowed.

(h) Non-destructive tests. All longitudinal and circumferential welded joints of the boiler shell shall be examined throughout their entire length by the X-ray or the Gamma-ray method of radiography. All welded joints to be radiographed shall be prepared as follows: The weld reinforcement on both the inside and the outside shall be ground, chipped and ground, or suitably machined to remove the irregularities of the weld surface so that it merges smoothly into the plate surface. The finished surface of the reinforcement may have a crown of approximately uniform amount not to exceed the following:

Plate thickness, in.	Thickness of reinforcement, in.
Up to ½, inclusive	1/16 maximum
Over ½ to 1, inclusive	1/16 to 3/32
Over 1	3/32 to 1/8

The films obtained by the use of X-rays shall be known as exographs and those obtained by the use of gamma-rays known as gammagraphs. Both types of films shall be generally termed radiographs.

The weld shall be radiographed with a technique which will determine quantitatively the size of defects with thickness equal to and greater than two per cent of the thickness of the base metal. To determine whether the radiographic technique em-

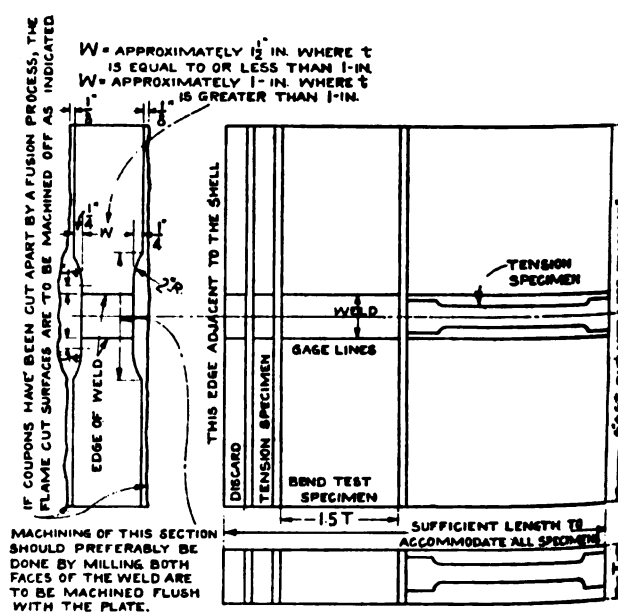


Fig. 2—The test specimen used for determining the strength of the welded joint

ployed is detecting defects of a thickness equal to and greater than two per cent of the thickness of the base metal, suitable thickness gauges or penetrameters shall be placed on the side of the plate nearest the source of radiation, and used in the following manner:

(1a) To determine whether the radiographic technique employed is detecting defects of a thickness equal to and greater than 2 per cent of the thickness of the base material, gauges or penetrameters of the following type shall be placed on the side

of the plate nearest the source of radiation and used as directed. The material of the penetrameter shall be substantially the same as that of the plate under examination. The thickness of the penetrameter shall be not more than 2 per cent of the thickness of the plates.

In each penetrameter there shall be three holes of diameters equal respectively to two, three and four times the penetrameter

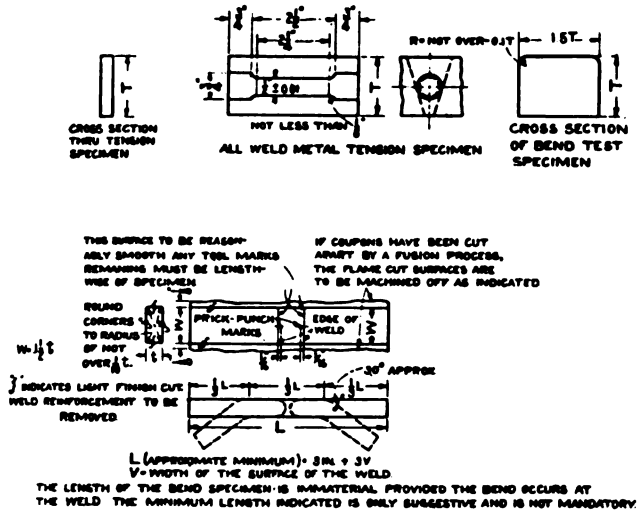


Fig. 3—Test specimens

thickness, but in no case less than 1/16 in., except when gamma-rays are used as a source of radiation, the minimum hole need not be less than 3/32 in. The smallest hole must be distinguishable on the radiograph.

Each penetrameter shall carry an identifying number representing, to two significant figures, the minimum thickness of plate for which it may be used. The images of these identifying numbers shall appear clearly on the radiograph. For plates up to 2½ in. in thickness, each penetrameter shall be 1½ in. long and ½ in. wide as shown in Fig. 4. Two penetrameters shall be used for each exposure, one at each end of the exposed length, parallel and adjacent to the welded seam with the small holes at the outer ends. The film during exposure shall be as close to the surface of the weld as is practicable. The distance of the film from the surface of the weld on the side opposite the source of radiation shall, if possible, not be greater than 1 in. With the film not more than 1 in. from the weld surface, the minimum distance between source of radiation and the back of the weld shall be as follows:

Plate thickness, in.	Minimum distance from source of radiation to back of weld, in.
Up to 1	14
1 to 2	21

There should also be a plain indication on each film showing the job number, name of boiler part, and seam, as well as the manufacturer's identification, symbol or name. If it is necessary to expose the film at a distance greater than one inch from the weld, the following ratio of

$$\frac{\text{Distance from source of radiation to weld surface toward radiation}}{\text{Distance from weld surface toward radiation to film}}$$

should be at least 7 to 1. When a grid of the Buckeye type is employed, to reduce scattered radiation, the above ratio may be reduced to 5. These conditions are imposed so as to obtain a practical maximum allowable distortion and magnification of any defect in the welded seam.

All radiographs shall be free from excessive mechanical processing defects which would interfere with proper interpretation of the radiograph.

Identification markers whose image will appear on the film shall be placed adjacent to the weld and their location accurately established by the inspector. The radiographs shall be submitted to the inspector. If the inspector requests, the following data shall be submitted with the radiographs: the thickness of the base metal, the distance of the film from the surface of the weld, and the distance of the film from the source of radiation.

The acceptability of welds examined by radiography shall be judged by comparing the radiographs with a standard set, which reproductions may be purchased from A. S. M. E.

In general, the standard of judgment shall be:

(1b) Welds in which the radiographs show elongated slag inclusions, or cavities, exceeding the permissible limits, or zones of incomplete fusion, shall be unacceptable if the length of any such imperfection is greater than ⅓ T, where T is the thickness of the weld. If the lengths of such imperfections are less than ⅓ T and are separated from each other by at least 6L of the acceptable weld metal, where L is the length of the longest imperfection, the weld shall be judged acceptable if the sum of the lengths of such imperfections is not more than T in a weld length of 12 T.

(2b) Welds in which the radiographs show any type of crack of zones of incomplete penetration, shall be unacceptable.

(3b) Welds in which the radiographs show porosity shall be judged as acceptable or unacceptable by comparison with the standard set of radiographs. A complete set of radiographs shall be retained by the locomotive builder and kept on file for a period of at least 10 years. If at the expiration of this time the locomotive builder no longer desires them, they may then be turned over to the purchaser at their request.

Preparation for Welding: (12) The plates to be welded shall be cut to size and shape by machining or shearing, or by flame cutting. If shaped by flame cutting, the edges must be uniform and smooth and must be free of all scale and slag accumulations before welding. The discoloration which may remain on the flame cut surface is not considered to be detrimental oxidation.

The edges of the plates at the joints shall not have an offset from each other at any point in excess of one-quarter of the plate thickness at the joint with a maximum permissible offset of ⅛ in., for both longitudinal joints and girth joints.

In all cases where plates of unequal thicknesses are abutted, the edge of the thicker plate shall be reduced in some manner so that it is approximately the same thickness as the other plate. See Fig. 5.

In longitudinal shell joints the middle lines of the plate thickness shall be in alignment within the fabricating tolerances specified above.

The design of welded courses or shells shall be such that bending stresses are not brought directly upon the welded joint.

No single welded butt joint or fillet weld shall be used where a concentrated bending stress will occur at the root of the weld due to bending of the parts joined, unless the parts are properly supported independent of the welds. Corner welds shall be avoided unless the plates forming the corner are properly supported independently of such welds.

(13) (a) Longitudinal, circumferential and other joints uniting the plates of the boiler shell or other parts shall be of the

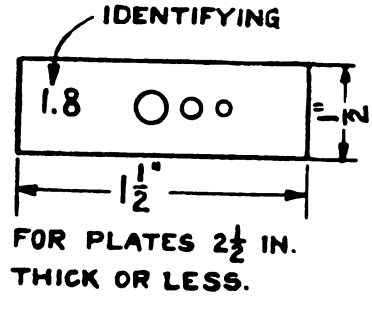


Fig. 4—Dimensions of penetrameters. The hole diameters are 2, 3 and 4 times the thickness of the penetrameter but not less than 1/16 in.

double-welded butt type and shall be reinforced at the center of the weld on each side of the plate by at least 1/16 in. up to and including ⅝ in. plate and up to ⅛ in. for heavier plates. The reinforcement may be removed, but if not removed shall be built up uniformly from the surface of the plate to a maximum at the center of the weld. Particular attention is called, however, to the importance of the provision that there shall be no valley or groove along the edge of or in the center of the weld, but that the deposited metal must be fused smoothly and uniformly into the plate surface at top of the joint. The finish of the welded joint shall

be reasonably smooth and free from irregularities, grooves or depressions.

(b) Heads concave to the pressure and plate edges at girth seams to be attached by butt joints shall be aligned so that the

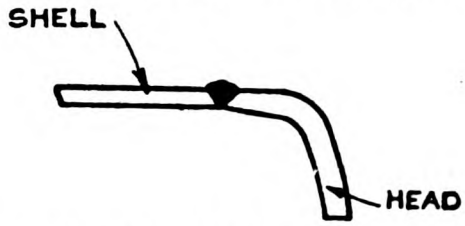


Fig. 5—Where plates of unequal thickness are joined the heavier plate is tapered to the approximate thickness of the lighter plate

deviations are not more than permitted by the limitations of Par. 12, but if greater, correction shall be made by reforming the shell or head, whichever is out of true, until the errors are within the limits specified. The edges of all double welded longitudinal and circumferential joints except those of the barrel courses are to be kept sufficiently separated at the point of welding to insure thorough penetration of the weld metal, as specified on the boiler drawing showing the preparation of the sheets for welding. The edges of the double butt welded longitudinal and circumferential joints of the barrel courses should be fitted together without separation, as specified for machine welding on the boiler drawing.

(c) Holes. The holes must not be located in any welded joint.

(14) The dome of the flanged one-piece construction is to be attached to the shell course in a manner similar to that shown in Figs. 6 and 7.

The weld joining the dome and shell course shall be subject to radiograph examination as covered in Par. 11 A. S. M. E. Code. The fillet weld joining the reinforcement to the shell course need not be subjected to radiograph examination.

Attachments to shell: (15) Pads for the insertion of studs, boiler check liners, washout plug bushings, and angles for dry pipe support may be welded to the shell. All other attachments to the shell shall be threaded, studded, or riveted, of ample strength to properly carry the load.

Stress Relieving: (16) The fusion welded boiler shell shall be stress relieved by heating uniformly to the proper temperature for the material used. The heating should be at the rate of 100 deg. F., per hr., with controlled cooling in the same manner. All connections attached by fusion welding shall be stress relieved. The structure shall be stress relieved by heating the complete boiler shell as a unit.

Distortion: (17) The cylinder or barrel of the shell shall be circular at any section within a limit ¼ in. on diameter, and if necessary to meet this requirement shall be reheated, rerolled or reformed. Tolerances for both longitudinal and horizontal alignment are to be maintained the same as is permitted for the boilers of riveted construction.

Inspection During Construction: (18) The inspector will witness the welding operation and inspect the welded joints, the shell in partly or wholly completed condition, the operation of stress relieving and the assemblage of other parts of the boiler at any or all stages as he may select.

Hydrostatic and Hammer Tests: (19) The fusion welded boiler shall be subjected to a hydrostatic test of one and a half times the designed pressure and while subject to this pressure all butt welded joints which are unsupported by other means, and all other welded joints where such a test is feasible, shall be given a thorough hammer or impact test. This impact test shall consist of striking the plate at 6-in. intervals on both sides of the welded joint and for the full length of all welded joints. The weight of the hammer in pounds shall approximately equal the thickness of the shell in tenths of an inch, but not to exceed 10 lb., and the plate shall be struck with a sharp swinging blow. The edges of the hammer shall be rounded so as to prevent defacing the plates.

Following this test, the pressure shall be maintained at not less than one and one-half the designed pressure and held there for a sufficient length of time to enable an inspection to be made of all joints and connections, after which the boiler shall be entered and the interior surfaces and connections examined as conditions will permit.

Pinholes, cracks or other defects shall be repaired only by chipping, machining, or burning out the defect to clear the metal and re-welding. This re-welding to be done before stress relieving so far as possible. For gas welding, the metal around the defects shall be preheated to a dull red for a distance of at least 4 in. all around. Any preheating means may be used, such as flange fire, gas or oil burner, or a welding torch. The preheating shall be done slowly, so the heat will get well back into the plate and expand it thoroughly. For metallic arc welding preheating or reheating is not required. After any repair welding, the area in the vicinity of the weld shall be stress relieved by heating to a dull red to equalize stresses and then cooled slowly. After repairs have been made, the boiler shall again be tested in the regular way, and if it passes the test, the inspector shall accept it. If it does not pass the test the inspector may order supplementary repairs, or, if in his judgment the boiler or other pressure part is not suitable for service, he may permanently reject it. The boiler to be absolutely tight at hydrostatic test.

Fire Test: (20) Draw off water to gauge level and fire up the boiler and test under own steam pressure to 20 per cent above designed pressure. Time to be consumed in raising required pressure to be from 2½ to 5 hr., depending on the water capacity, after which reduce the pressure to 50 per cent of designed pressure, then raise steam again to required pressure. The boiler to be made tight under this lowering and raising of the pressure. Leaks in welded seams must not be caulked. Blow-off steam pressure and then slowly drain the boiler of all contents.

Reinforcement of Openings: (21) All openings over 3¼ in. in diameter or/and exceeding four and a half times the thickness of the plate, in unstayed surfaces, must be suitably reinforced.

Firebox Welding: (22) The fusion welding of the internal firebox, where the stress is carried by other construction, and where the safety of the structure is not dependent upon the strength of the weld need not be stress relieved or radiographed.

Rivet Holes: (23) Rivet holes for attaching bracing, etc., to be drilled in the flat sheet at least 3/16 in. small and reamed to the exact size after the plates or parts are assembled to insure uniform holes, then slightly countersunk and the edges of the holes rounded to a 1/16-in. radius. The use of draft pins will not be allowed. Rivets to be driven hydraulically where possible.

Flanging: (24) The boiler and firebox plates to be hydraulically flanged, the reduction of cross-section to be a minimum.

Tube and Flue Setting: (25) Tube and flue holes in the tube sheets to have sharp edges removed from both sides of the sheet. The tubes and flues to be swedged to fit standard ferrules in the

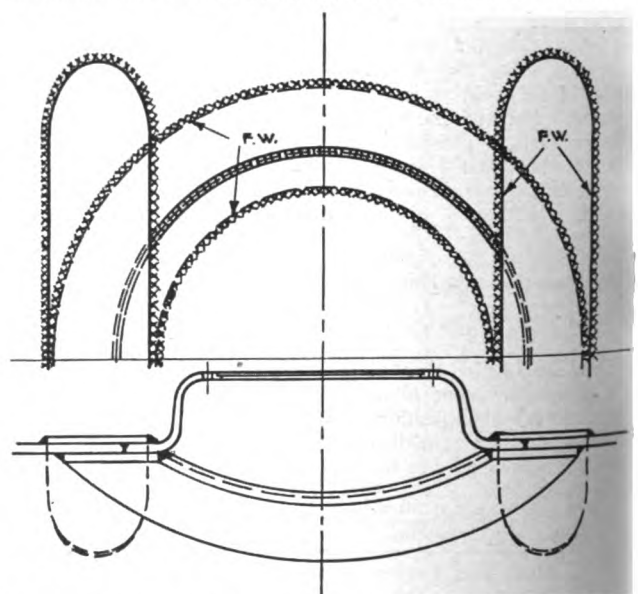


Fig. 6—Showing method of attachment of flanged one-piece dome to the shell course

firebox. No ferrules in the front tube sheet. Tubes to be rolled and beaded both ends.

Firebox Ring: (26) The firebox ring to be of solid rectangular cross-section of cast-steel single or double riveted.

Staybolts: (27) Maximum allowable stress per square inch of net cross-sectional area on the firebox stays at designed pressure shall not exceed 7,500 lb.

Braces: (28) Maximum allowable stress per square inch of net cross-sectional area on round, rectangular and gusset braces at designed pressure shall not exceed 8,500 lb.

Flexible Staybolts: (29) The welds attaching the flexible type staybolts having welded type sleeves or caps, used in the construction of this boiler, need not be stress relieved.

Other Welding: (30) Applications of fusion welding in construction of parts not specifically referred to in this specification

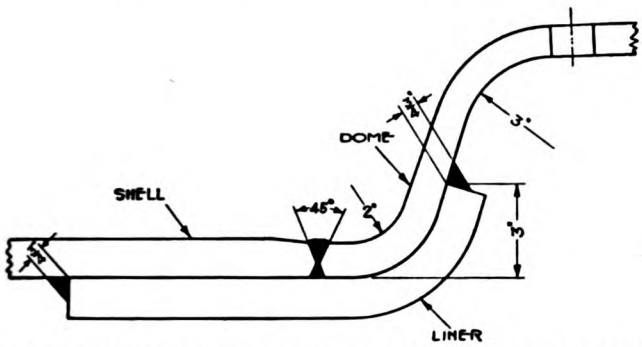


Fig. 7—Detail of a method of applying dome to an all-welded boiler

and applications of fusion welding in making repairs to any part of the boiler after the boiler is placed in use will conform to established practice in the application of repairs to locomotive boilers of conventional construction.

Material Specifications: (31) The following material specifications to be used—flange or boiler steel—A.S.T.M. Spec. A-201-Grade A, semi-killed suitable for welding by submerged weld process.

Firebox Steel: A.A.R. Spec. E-M 115, Grade A.

Tubes and Flues: Steel, A.A.R. Spec. M-108.

Staybolt Iron: Flexible bolts, rigid bolts, A.A.R. Spec. M-305.

Angles, Tees: A.A.R. Spec. E-M 116, Grade B.

Braces: Rod braces to S.A.E. composition 1022 or A.I.S.I. composition C 1022. Soft steel.

Rivets: Steel, A.A.R. Spec. M-110.

Steel Castings: A.A.R. Spec. E-M 201, Grade B.

Studs: Tube sheet studs for header casting, and cab turret studs, Society of Automotive Engineer's Spec. No. 1035 normalized and tempered.

Other Studs: Society of Automotive Engineer's Spec. No. 1020.

Recommendations

The committee is quite confident that boilers so constructed can and should be made a standard fabrication procedure. And further, the committee recommends in this report the all-welded type locomotive boiler.

The members of the committee are E. H. Heidel (chairman), general boiler foreman, C. M. St. P. & P.; A. F. Stiglmeier (vice-chairman), general supervisor boilers and welding, N. Y. C.; H. A. Bell, general boiler inspection, C. B. & Q.; F. C. Haase, general manager, Oxweld Railroad Service Company; J. H. Lewis, assistant general boiler inspector, A. T. & S. F.; A. G. Trumbull, chief mechanical engineer, C. & O.; W. R. Hedeman, engineer of tests, B. & O.; E. Magee, welding foreman, C. R. R. of N. J., and J. W. Kenefic, district superintendent, Air Reduction Sales Co.

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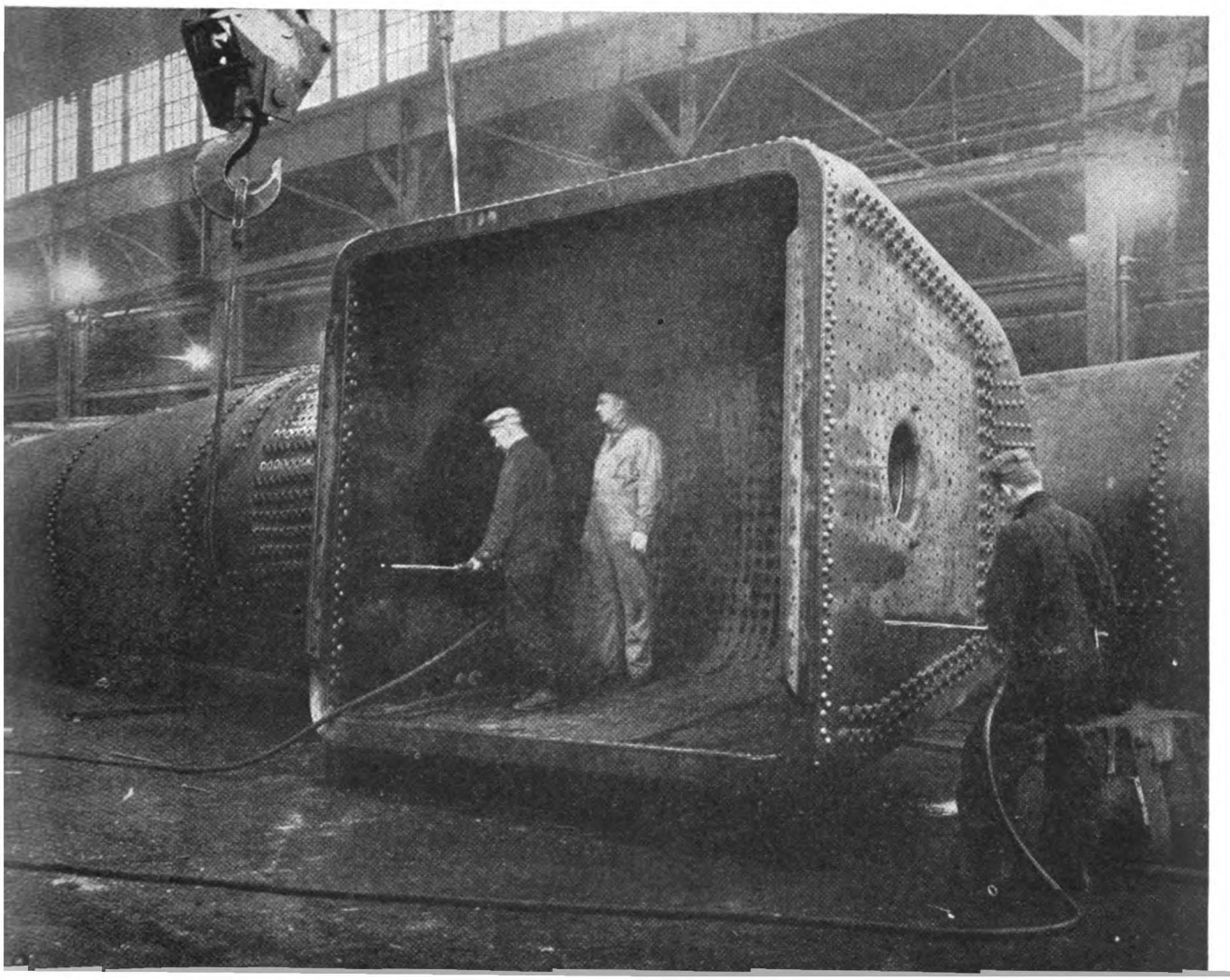

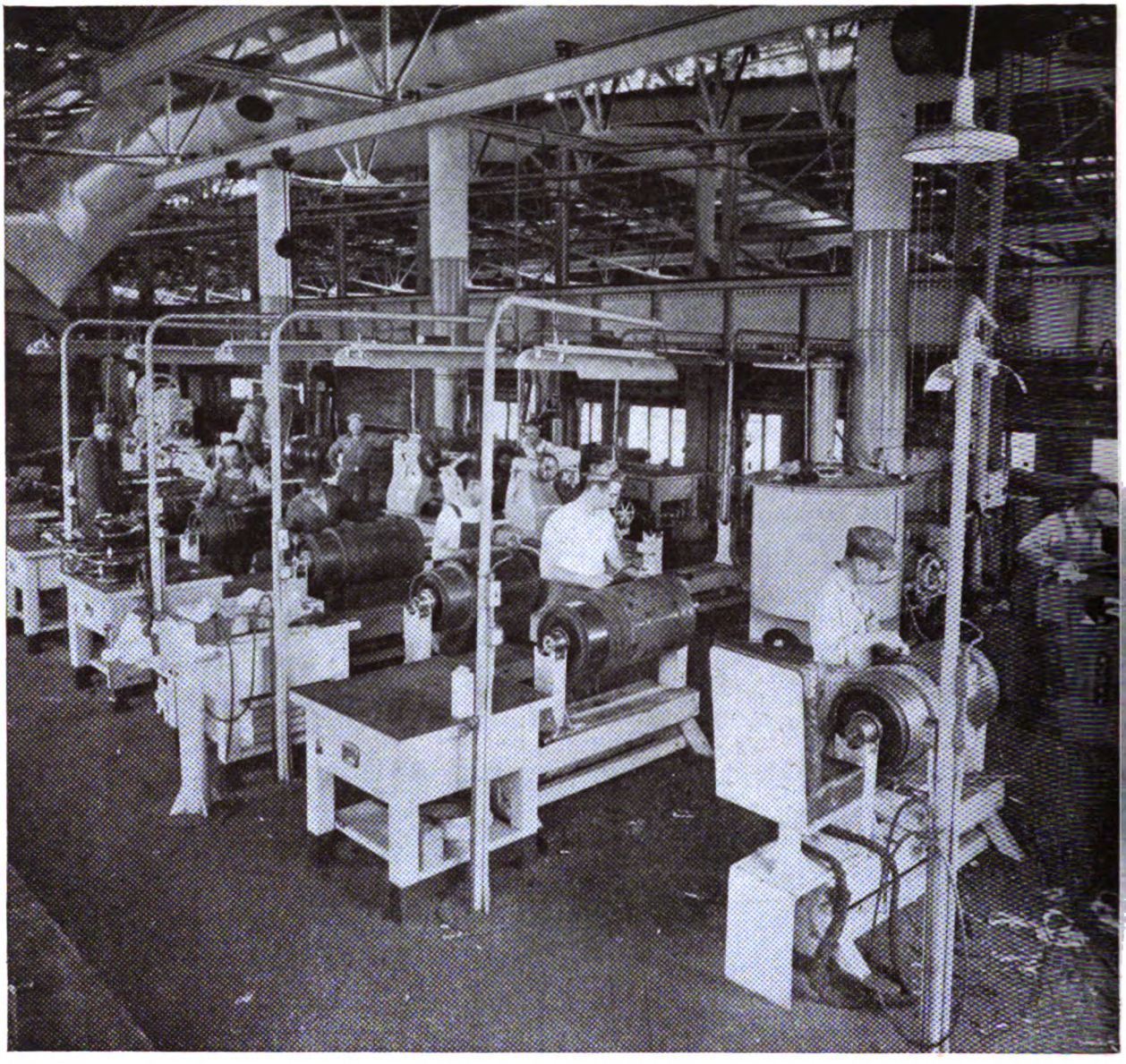

Electrical Section

Featuring
Electrical Shop Devices . . .

Cleaning Electrical Windings

By D. L. Gibson*

Suggested procedures for meeting the various kinds of cleaning requirements

THERE are several rather simple methods that can be used for cleaning windings, rotors and stators of electrical equipment and the one, or combination, to use depends upon the reason for cleaning the machine. Cleaning of apparatus and insulation goes beyond simply wiping off the surface with solvent; or removing old coils and scraping the slots free of varnish. Money, time and labor can be saved on cleaning and on subsequent operations if the jobs are analyzed and proper methods used.

Machines which are being rehabilitated by another varnish and ovenbake dip require a type of cleaning that will remove grease, dirt and carbon dust, but not damage the insulation. For stators or rotors which are to have the coils removed and then rewound, a method can be used that not only eliminates dirt and grease, but also softens the varnish film to facilitate removal of coils, cleaning of vent ducts, and of frames. Proper cleaning of laminations and slots can be achieved by still another method. In some cases machines may require special cleaning with water or solvents due to exposure to chemical fumes, salt water, or flood waters.

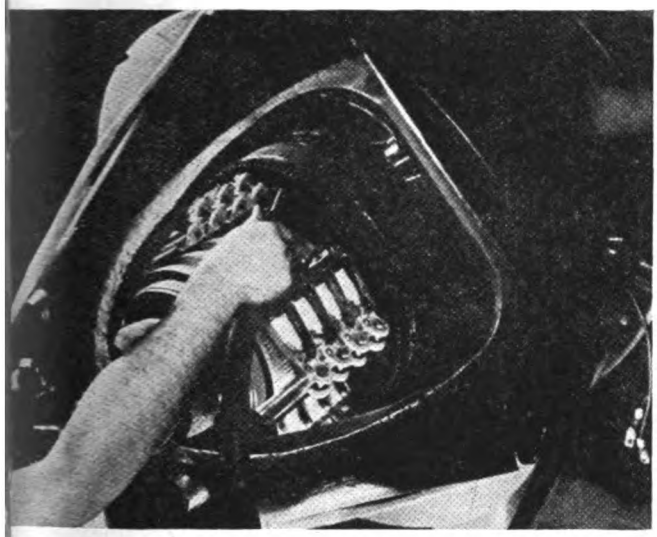

Fig. 1—Removing loose dirt from rotor winding with compressed air—Air pressure should be kept between 40 to 50 lb., otherwise there is danger of loosening insulation material

These examples indicate the need for careful analysis of the cleaning problem and of making provision for facilities to do the job economically. Usually, adequate temporary equipment can be installed to take care of the special cleaning necessary.

Standard methods of cleaning insulation include: wiping the parts with lintless cloths soaked with solvent; blowing the dirt out with air pressure; drawing the dirt off with vacuum cleaning apparatus; spraying or immersing in solvents; and washing with water. Specialized methods include the use of vapor degreasing and the use of the steam "jenny." The methods used will depend upon the varnish treatment of the apparatus and conditions involved.

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Machines treated with asphalt base varnishes cannot be cleaned by vapor degreasing unless complete stripping and removal of varnish is contemplated. Low-powered solvents should be used on asphalt base varnishes if the film is not to be removed. Synthetic varnishes will stand more severe cleaning methods than asphalt varnishes without injury to the film.

Cores stripped for rewinding may be further cleaned by sand blasting, vapor degreasing or solvent immersion. This discussion applies to machines that may be dismantled to be cleaned or machines that can be taken to repair shops for an overhaul. The following methods do not apply to high voltage machines of 4,000 volts and over. These require special cleaning processes with low-powered solvents.

Blowing Out and Drawing Off Dirt

Blowing out dirt with air at about 40 to 50 lb. pressure is usually effective, particularly in inaccessible places as illustrated in Fig. 1. However, use of air merely removes the loose dirt, and does not disturb the embedded material. Cleaning can be done quickly with compressed air, however, the air should be dry and clean; the windings should not receive the full force of the air pressure. Equipment to be cleaned should be given a preliminary going over with air pressure to remove the loose dirt. Care should be exercised in using air, however, to prevent blowing dirt into cracks in the insulation. If vac-

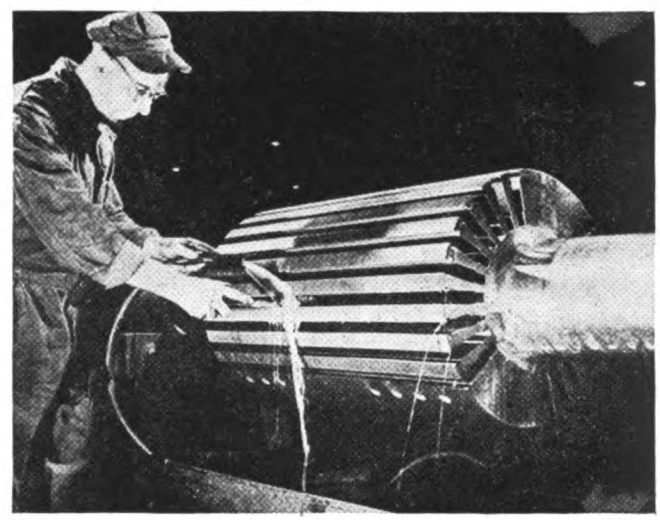


Fig. 2—Cleaning grease, oil metal chips and dirt particles from a slotted rotor with solvent—Note brush used to insure complete removal of contamination within slots

Table I—Specifications for Standard Petroleum Solvents

Values	Xylene substitute	Mineral spirits	Naphthenic mineral spirits	High flash mineral spirits
Sp. gr. at 15.5 deg. C.	0.77-0.80	0.76-0.79	0.81-0.82	0.77-0.79
Pounds per gal.	6.4-6.7	6.3-6.6	6.7-6.8	6.4-6.6
A.S.T.M. distillation deg. F.				
Initial boiling point	290	305	310	325
50 per cent over	305	345	340	350
90 per cent over	315	370	370	370
Dry point	325	395	395	395
Kauri-Butanol value	36—47	31—40	42—46	34—36
A.S.T.M. flash point deg. F.	85	103	105	115

uum cleaning equipment is available it should be used, as it does a good cleaning job and in addition does not distribute the dirt around the shop.

Use of Solvents

When the accumulation of dirt on the frame and insulation contains oil and grease, an organic solvent will be required to remove it as shown in Fig. 2. Solvents for oil and grease can be applied by wiping with lintless cloths moistened with the cleaning fluid. Obviously, this method cleans only the readily accessible places. Pressure spraying or immersing the parts in a bath of the solvent reaches the inaccessible parts. The immersion method entails some hazard caused by the maintenance of tanks of solvent. However, small motors can be easily cleaned by hanging on racks and dipping in solvents.

These methods adequately clean the surface of the machine for repairs, or of the insulation for additional varnish treatment or for removal of a few coils. They do not clean out vent ducts, dissolve varnish, loosen coils in the slots, or clean slot laminations. The baked varnish film is rarely injured.

In general there are three types of organic solvents in use, for cleaning: (1) Petroleum distillates of low solvency power; such as mineral spirits or a high flash dry cleaning solvent known as Stoddard's solvent, or cleaner's naphtha; (2) petroleum distillates of a medium solvency power; such as naphthenic mineral spirits, and (3) carbon tetrachloride.

Typical analyses of several petroleum cuts are given in Table 1. Solvents are purchased to such specifications. Those for cleaning purposes should have flash points of approximately 100 deg. F. or greater and a solvency power (kauributanol value) in the range of 30-45. Such solvents are inexpensive. They evaporate leaving little or no residue. It should be remembered that high flash

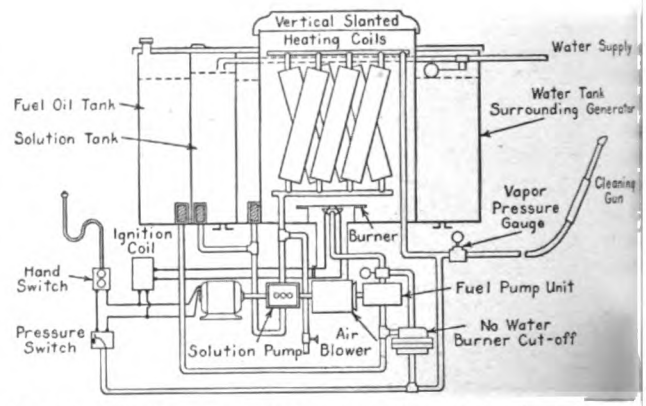


Fig. 4—Typical arrangement of a steam "Jenny" that is used to clean surfaces with hot water under pressure

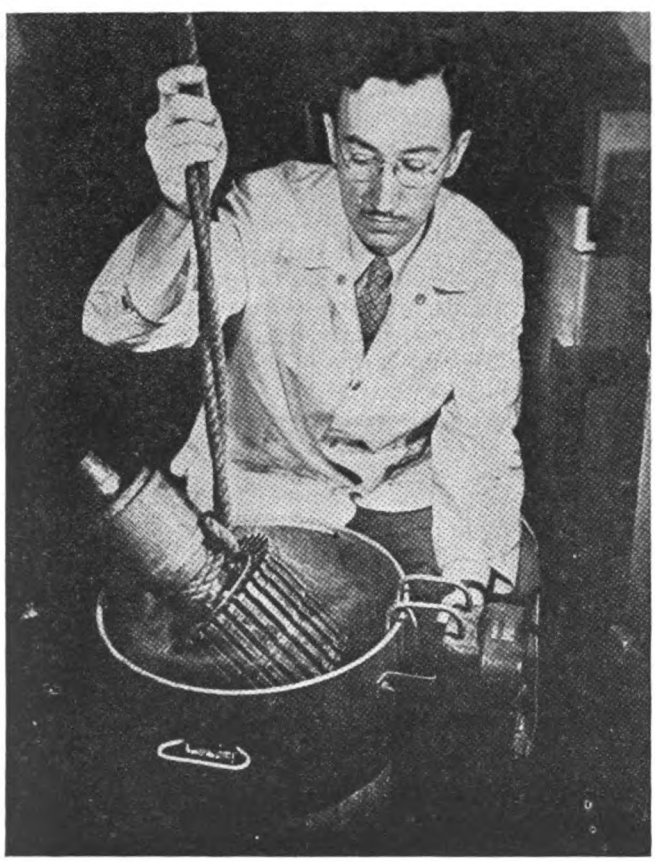


Fig. 3—Cleaning slotted rotor and commutator of small motor by vapor degreasing method—An electrical emersion heater raises the temperature of the cleaning solvent, trichlorethylene, to the vaporization point only—Cleaning action results from condensing of hot solvent vapors which washes off dirt and grease

point solvents minimize the fire hazard, but they are inflammable. The necessary precautions and facilities should be provided for storing flammable liquids. Usually, insurance regulations provide adequate instructions for storage of solvents.

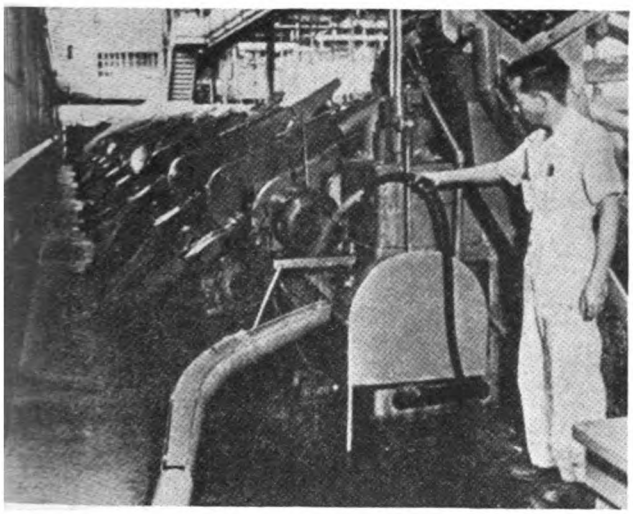
Petroleum solvents are the least toxic but ample ventilation should be furnished, as should the necessary fire precautions. Carbon tetrachloride is non-inflammable, but extremely toxic, and of very high solvency power. This should be used only when a very severe dirt condition is encountered, and then only with special health precautions. In some cases, carbon tetrachloride is mixed with the petroleum solvents to increase their cleaning power, and decrease the fire hazard. A mixture of 50 per cent carbon tetrachloride and 50 per cent mineral spirits is non-inflammable, but the vapors mixed with the right proportions of air are explosive. In no case should alcohol, benzol, or toluol be used. They are severe, will dissolve or soften the varnish present, are extremely toxic, and are fire hazards. Petroleum distillates of low solvency power will not attack the baked varnish films present but will dissolve oil, grease and loosen dirt. Some air drying varnish films will be softened by petroleum solvents.

Vapor Degreasing Method

For some years the metal finishing or process shops have utilized vapor degreasing tanks for cleaning surfaces prior to further handling or finishing with enamel or paint. This method utilizes the principle of condensing hot solvent vapors on the metal to be cleaned, which washes off the grease and dirt, through a continuous condensing process as shown in Fig. 3. The washing

ılvent is always clean, since it condenses on the surface om a vapor. Solvents used are high boiling, toxic, non-flammable, chlorinated compounds called trichlorethylene and perchlorethylene. Sold under various trade ames, these compounds are brothers to carbon tetrachloride, and are known to the chemist as unsaturated mpounds. The degree of unsaturation or double bond dicates chemical activity, the chlorine atom gives high lvency to the molecule, as well as non-inflammability. his combination gives a material which attacks or dislves greases, oil, dirt, enamels and varnish films, and any organic chemicals. However, these solvents have dissolving effect on shellac and some organic enamel nishes. Trichlorethylene boils at 87 deg. C. (188 deg. .), while perchlorethylene boils at 121 deg. C. (250 eg. F.).

Such principles may be adapted to clean wound cores other equipment where all the coils are to be removed, where equipment is to be rewound, vents and metal oroughly cleaned. The hot vapors condensing on the quipment attack the dirt, grease, and varnish film. The lvent softens and dissolves the varnish around the coils that stripping is accomplished easily, and laminations e not damaged on coil removal. If slots and laminaons are to be further cleaned, the core may be returned fter stripping for another cleaning cycle. This method not to be recommended where only the insulation surace is to be cleaned and the wound core given a coat of arnish and baked. Some use has been made of the



g. 5—In some applications, sanitation demands continuous washing of uipment with boiling water and compressed air; though not ordinary otors—These must be of totally enclosed types before it is safe to try to clean them as shown

rocess for surface cleaning, where the machine has been eated with certain synthetic varnishes, and careful conol is exercised in the degreasing process. However, the ntrol must be precise, so that the vapors will not soften e varnish film.

The degreasing process is carried out in a tank, heated steam or gas, and provided with cooling coils, on the ner walls. There are patented degreasing chambers on e market, which are furnished and installed by compaes specializing in this method. In this operation, the eaning solvent is brought to vaporization or boiling. hen the vapor rises to the condensing coils, located near e top of the chamber. The apparatus to be cleaned is wered below the vapor line into the vapor, which conenses immediately in a steady stream on the piece. When quipment reaches the temperature of the vapor, condenation stops and the cleaning process is completed.

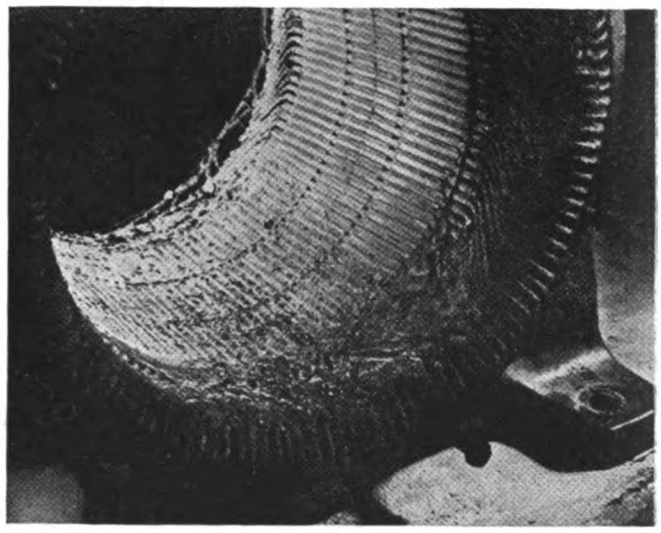


Fig. 6—Dirt accumulation in stator as result of being immersed during a flood—The thickest layers can be removed by immersion in warm running water and then using a brush

Cleaning by Use of Steam "Jenny"

Some success has been achieved in surface cleaning by use of hot water under pressure. Portable steam "jennies" are available with special jet guns and nozzles to eject hot water vapor at 60 to 70 lb. (nozzle pressure). Such a device, outlined in Fig. 4, heats flowing water and ejects it in vapor form through a cleaning gun or nozzle under pressure. This method is efficient particularly for removal of dirt, dust, mud, or chemicals. Attachments are available to feed so-called neutral soaps or solvents into the vapor stream. The soap emulsifies grease or oils present and makes them easily removable. The use of strong alkali soaps should be avoided due to their injury to varnish films and the danger of leaving conducting particles on the insulation. The temperature of the water or soap solution should not be above 90 deg. C. (194 deg. F.), and the pressure at the windings not over 25 lb. per sq. in. Neutral soaps have little effect on the baked varnish film and insulation, however, the operation should be completed by a rinse in warm, clean water. This method does not aid in the removal of coils, but it does clean the surfaces for further repair, or varnish treatment.

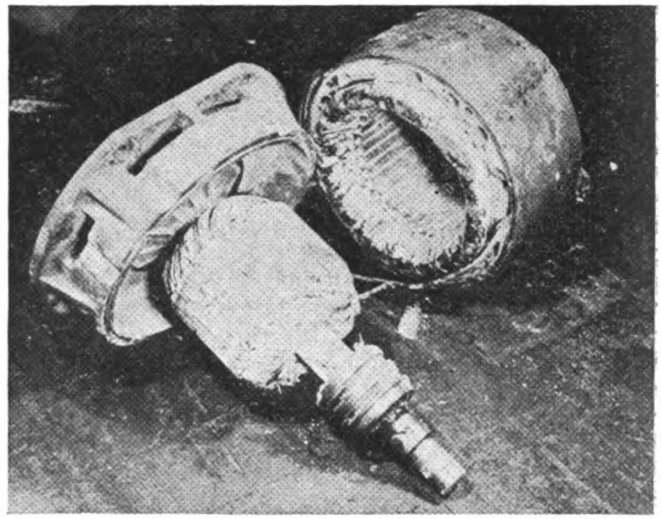


Fig. 7—Contamination of stator and rotor of small motor that had been used in a chemical plant—Running warm water and a brush will quickly remove the heaviest layers of dirt and dust

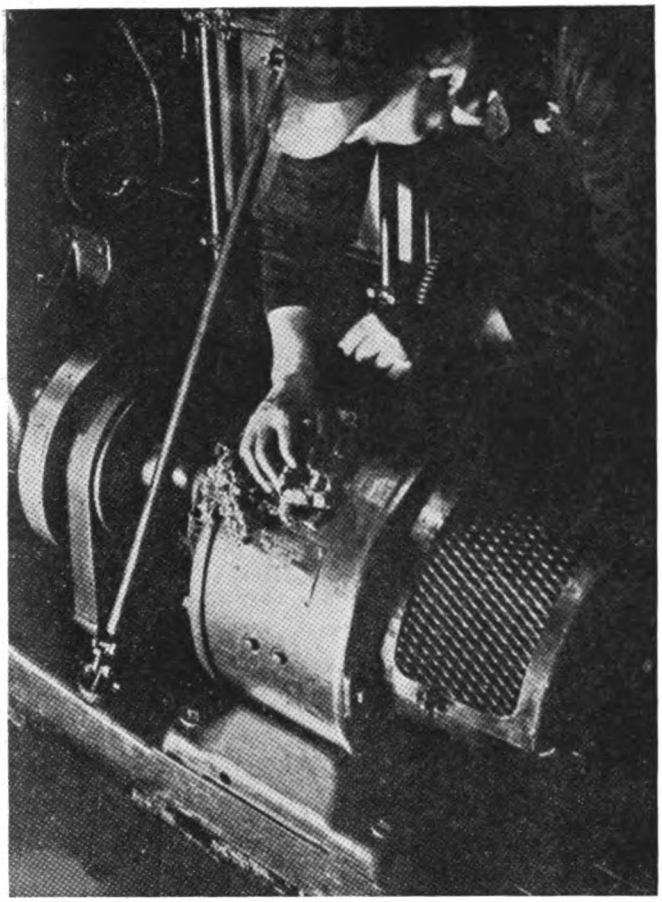


Fig. 8—Regular wiping off of the motor will do much toward keeping it in first class shape—This should be an essential part of plant housekeeping program

Cleaning by Immersion in Water

Electrical apparatus which has been in flood waters, and is clogged with silt and mud (Fig. 6), or equipment exposed to water soluble chemicals (Fig. 7), probably needs to be cleaned by immersion in water. Some chemicals to which modern electrical machinery is exposed are soluble in water, and become embedded in grease as a hygroscopic slime. These can best be cleaned by immersing the dismantled parts in running water at 52-57 deg. C. (125-135 deg. F.), scrubbing the metal with brushes and wiping the insulation with lintless rags. After water immersion the machines or parts may be given additional cleaning with a steam "jenny."

With any process where water is used on electrical windings care must be taken to dry out the equipment slowly so as not to damage the insulation by formation of steam. There are three methods of drying winding insulation: (1) Internal heat; (2) external heat, and (3) combination of internal and external heat.

Shops where electrical machinery is maintained and repaired should have a forced draft ventilated oven capable of reaching 135 deg C. (275 deg. F.). This could be used for baking of varnish and the drying of machinery after cleaning with solvent or water. When water has been used for cleaning it is preferable to dry the windings in an oven. Regardless of the heating method used, it is recommended usually to limit the first bake to a maximum of 75 deg. C. (167 deg. F.) on the windings, and to raise the temperature slowly to 110 deg. C. (230 deg. F.), maximum for Class A windings and to 130 deg. C. (266 deg. F.), maximum for Class B windings. Frequent insulation resistance readings should be made and curves plotted for future reference, in order to standardize bakes for certain classes and types of machines. The drying time necessary is controlled by the size of the machine, and the heating methods used, as well as the condition of the windings.

Cleaning Cores

Cores can be further cleaned after the coils have been removed by use of a blast of fine sand, applied under pressure. Slots can be cleaned in this manner preparatory to rewinding. However, the operation has to be controlled carefully, in order not to burr laminations, or remove steel from the punchings. There is some question as to the effect on core losses, but there are reports that this method is being used on certain types of cores. The cleaning is carried out by a blast of sand directed through a hand gun at 75 to 85 lb. pressure (at the nozzle). Cores to be cleaned are placed on a special revolving platform which contains hoppers for the sand. All sand is screened automatically before re-use. By means of the hand gun the blast in the slots is directed parallel to the length of the core. Such a method thoroughly cleans all recesses.

Conclusions

It is not advocated that facilities for such diversity of methods be kept available. However, apparatus to be cleaned should be analyzed thoroughly and the proper methods used to remove the type of contamination. Considerable thought should be given to the type of dirt and foreign matter present. It may be possible that a majority of equipment to be cleaned falls within a certain category, and a suitable method can be installed to speed the process. Proper methods save money, time and labor.

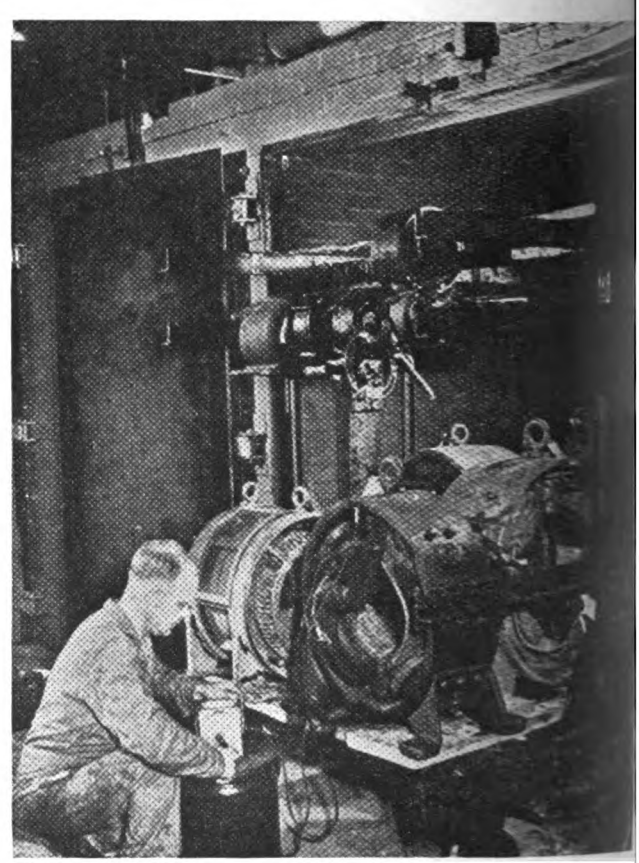
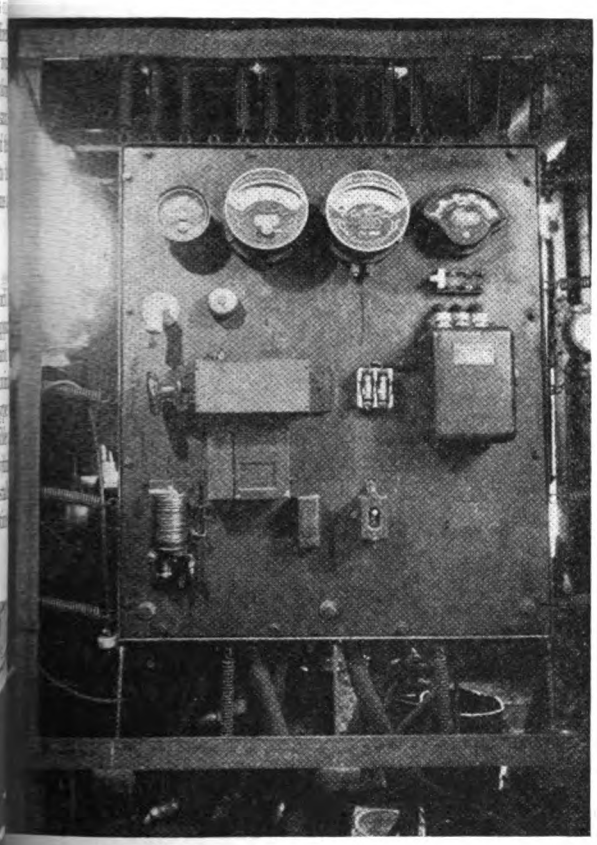


Fig. 9—Measuring insulation resistance of stator windings during baking out—This is essential test procedure at this point as it indicates condition of insulation

oad Testing Traction Motors

Union Pacific insures the performance of traction motors by a load test made before rebuilt motors are replaced on Diesel-electric locomotives

FEATURE of the very complete Union Pacific electrical ir facilities at Omaha, Neb., is a car equipped for ting load tests on Diesel-electric locomotive traction ors. The procedure has repeatedly proved its value lisclosing faults which do not become evident until the or is loaded and hot and which if not discovered would have caused motor failures on the road. A characteristic fault of this kind is the failure of insulation between coils. Improper banding, soldering, commutator bearing, shaft alignment and gear conditions may also be disclosed. The motors are normally tested with their own support bearings, pinions and gears. They are run at full load for four hours at a speed corresponding to 45 m.p.h. after which the speed is increased to 90 m.p.h. at which speed the motor is run at light load for half an hour.



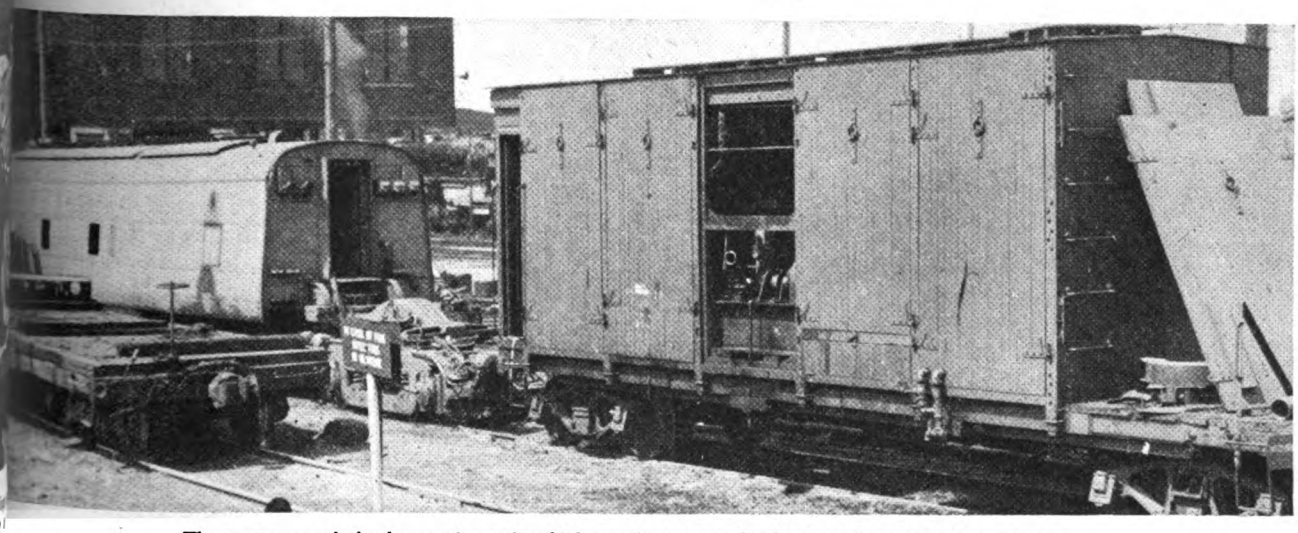
control board in the test car is supported on springs and is fitted a voltmeter, an ammeter, a speed regulator, a ground relay and contactors

Under load test the temperature of the commutator is allowed to rise to 240 deg. F. and exhaust air from the fields to reach 180 to 190 deg. F. The temperature of the commutator is measured with a hand pyrometer and cooling air temperature with a recording thermometer.

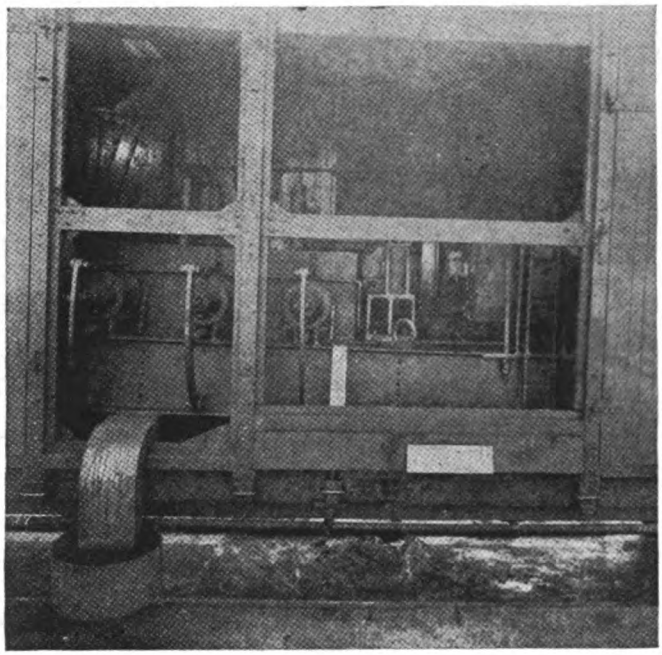
All motors are rewound with hot-pressed, slot-size coils and all rewound motors are load tested. Gears and pinions are matched; the same gear and pinion being kept together when a motor is overhauled.

Test Equipment

The apparatus used for load testing is housed in a box car which at present receives the necessary power from a retired Diesel-electric locomotive unit having a 1,200-hp. engine and generator. The test stand in the car consists of a mount for the motor which allows the motor gear to mesh with a bull gear which is twice the size of the motor gear. The large gear is on a shaft on which there are also six flanged car wheels fitted with clasp brakes. The wheels and brakes are in a steel tank. During a test,



The test car and the locomotive unit which supplies power for load testing of traction motors



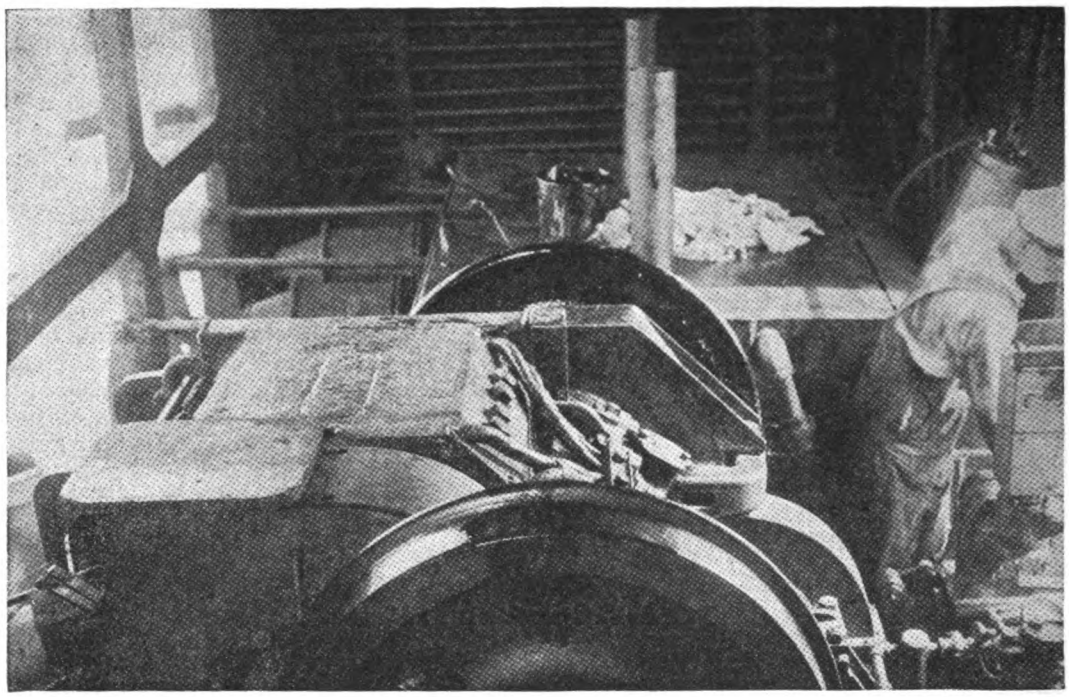
One side of the test car showing the cylinders for operating the clasp brakes—The outlet for the cooling water appears in the foreground

A pump-back method of testing was considered b not used, as it would involve reduced voltage and wou not so closely simulate road operating conditions. Pla have been made for testing two motors simultaneousl using power from a Diesel engine and generator whi go through the shop at the same time the motors a overhauled.

2,660 Megacycles

The Chicago, Rock Island & Pacific has announced tha in cooperation with the Sperry Gyroscope Company, a installation of radio telephone train communication is be made on 160 miles of double track between Chicag and Rock Island, Ill., using ultra-high frequency wav (2,660 megacycles). The equipment will include Kly stron tubes manufactured by the Sperry Gyroscope Com pany for military and naval radar operations, hitherto war secret. In contrast with the conventional antenna an assembly of platters or discs is mounted on a sho hollow tubing only a few inches tall, this being an im portant factor in railroad applications where the clea ance on cars and locomotives is limited.

The Rock Island has a license from the Federal Com munications Commission to make tests in this ultra-hig



Interior of the test car showing the motor under test in foreground and the metal box containing the six flanged car wheels with their clasp brakes

cooling water flows over the wheels. The water is not recirculated, fresh water at a constant temperature being applied and allowed to drain off to a drainage sewer.

The brakes are applied through a special brake rigging, shown in the illustrations, by a hand-operated air valve. The hand operation may be replaced by an automotive governor.

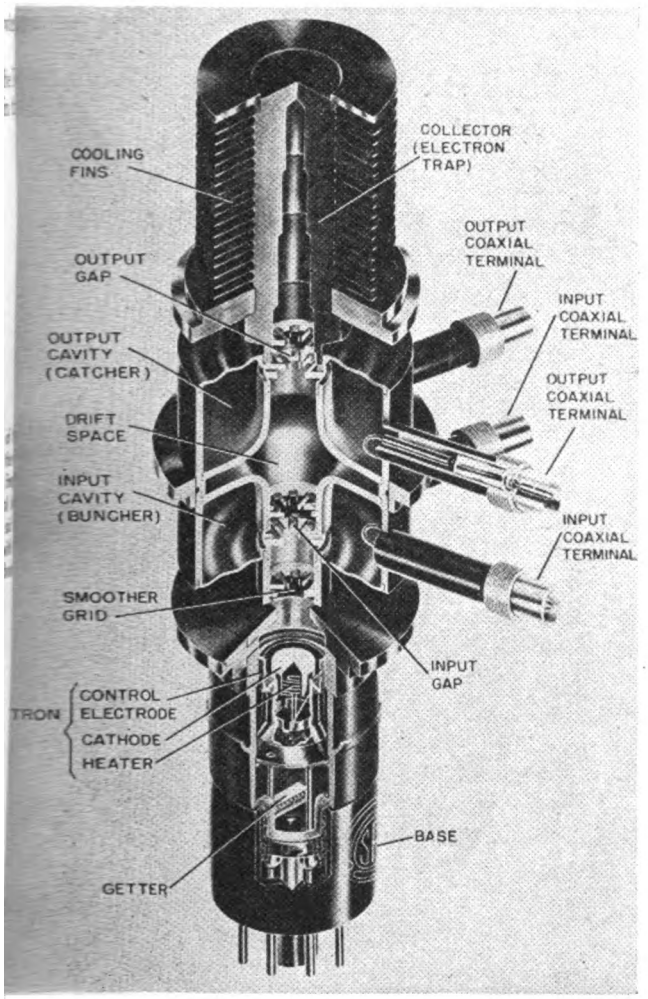
Ventilating air is supplied by a motor-driven blower which furnishes the same rate of air flow used on the locomotive.

The control board is fitted with a voltmeter, an ammeter, a speed recorder, a ground relay and contactors. The panel is suspended on springs to protect the instruments from vibration.

Speed is controlled entirely by braking, operating voltage being held on the motor throughout the test period.

frequency range at 2,660 megacycles. The equipment, which is crystal-controlled, is operating with a power of 10 watts with a frequency modulation signal 150 kilocycles wide. The 60 channels assigned by the Federal Communications Commission to the railroads for head-end to rear train service are located in the 152-162 megacycle band, which is far below the 2,660 megacycles being tested on the Rock Island. Successful operations in ultra-high frequency on the Rock Island are said to open up, for possible use, a portion of the radio spectrum in which there are an enormous number of unused channels. The Rock Island has been assured that a permanent operating license at 2,660 megacycles will be granted as soon as tests have demonstrated the advantages of using ultra-high frequency. For some time, this type of equipment has been in regular service on one through freight train

o types of ultra-high frequency antennae are inspected by J. D. rington (center), chief executive officer, Rock Island; Ernest l (left), electronics engineer, Rock Island, and Dr. H. H. Willis, **vice-president, Sperry Gyroscope Company**



A Klystron tube cut away to show its internal construction

rating daily between Rock Island and Kansas City. e advantages claimed are that the ultra-high frequency ıot subject to fade-out or blind spots under any adse conditions such as gorges, tunnels or steel bridges.)n the installation to be made between Chicago and :k Island, the Sperry Gyroscope Company is to furı all of the equipment required except for power supapparatus. Locomotives and cabooses assigned for ɔugh freight trains are to be equipped first, and the project will then be extended as fast as practicable to other trains, as well as to certain wayside stations. The first locomotive and cabooses to be equipped with the latest types of the radio apparatus are expected to be ready for service in November.

The Klystron Tube

When the Sperry Gyroscope Company first developed its velocity-modulated, ultra-high frequency tube, it registered the word 'Klystron" as the name of the new device. This name—from a Greek word denoting the breaking of waves on a beach and coined by scientists of Stanford University—is an apt description of the bunching of electrons between spaced grids within the tube. The Klystron produces a pencil of energy beamed like light, reflectors being used for this purpose.

The Klystron converts direct-current energy into radio frequency energy by modulating the velocity of an electron beam between spaced grids.

The Rock Island installations will be under the direction of C. O. Ellis, superintendent of communications; E. A. Dahl, electronic engineer, and A. E. Ganzert, electrical engineer.

Control Circuit Test Panel

The test panel shown in Fig. 1, conceived in the shops of the Union Pacific at Omaha, Neb., makes the checking of Diesel-electric locomotive control circuits easy and certain. At the top of the panel are a number of 64-volt lamps arranged in four rows of seven lamps each. Over each lamp is a letter or code marking corresponding to one of the control-circuits in a locomotive. From the test panel are run two cables each terminated in a 16-contact

Fig. 1—Panel for testing the proper functioning of control devices and the continuity of control circuits in A units of Diesel-electric locomotives

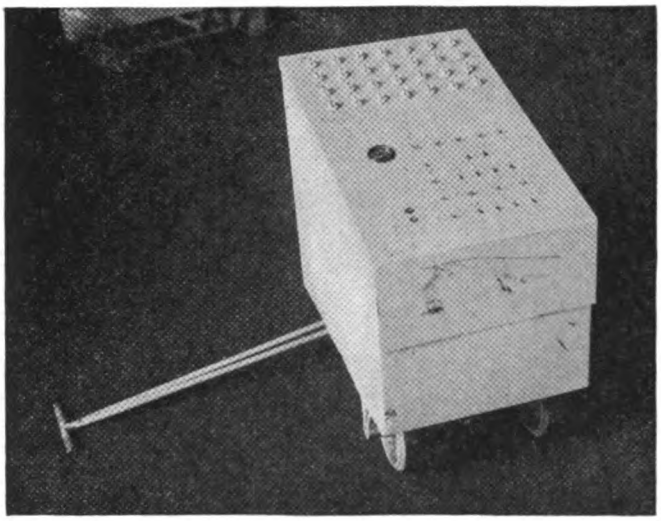


Fig. 2—Panel for testing control circuits of Diesel B locomotive units

multiple plug identical with those normally used between locomotive units. Each lamp on the panel is connected to the proper contact of one of the plugs so that it will light when that particular circuit is operated from the control position which is at the front of the locomotive unit.

There is also a telephone on the test panel which is connected by a separate pair of leads with another in the locomotive cab. When the circuits are being tested, a man in the cab operates the various switches and control devices, each operation applying or disconnecting the 64-volt battery power to one or more of the control circuits. The test panel is normally placed on the ground near the rear of the locomotive unit. By means of the telephone, the man in the cab advises the man at the board what connections have been made and the man at the panel checks the operation by watching the lamps and advises the man in the cab. Since the plugs used are master plugs, the operators cannot make a mistake by connecting a test lamp to the wrong circuit. Indications on the board are *B* plus for positive battery, *PC* for positive control circuit, *OSL* for oil signal alarm, *TSL* for hot engine alarm, *A, B, C,* and *D* for throttle sequence, *ABP* for brake application, *FOR* and *REV* for reverser operation, etc.

The test panel shown in Fig. 2 is being developed for the testing of control circuits in B locomotive units. The toggle switches on the lower half of the panel energize the B control circuits in the same manner as the control devices on an A unit and 64-volt power is supplied by a small motor-generator set in the test panel. The sockets at the top of the panel will contain the circuit indicating test lamps.

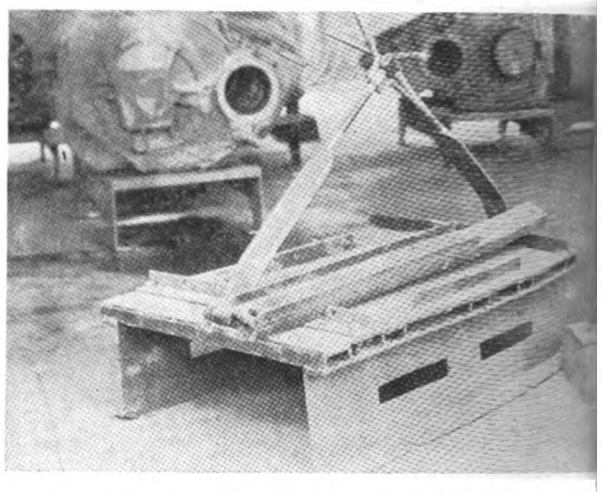
Adjustable Motor Skid

For handling Diesel-electric traction motors in its repair shop at Silvis, Ill., and for shipping of motors to and from other locations, the Rock Island is now using an adjustable motor skid which can be used with motors of various sizes and handled easily with different types of lift trucks.

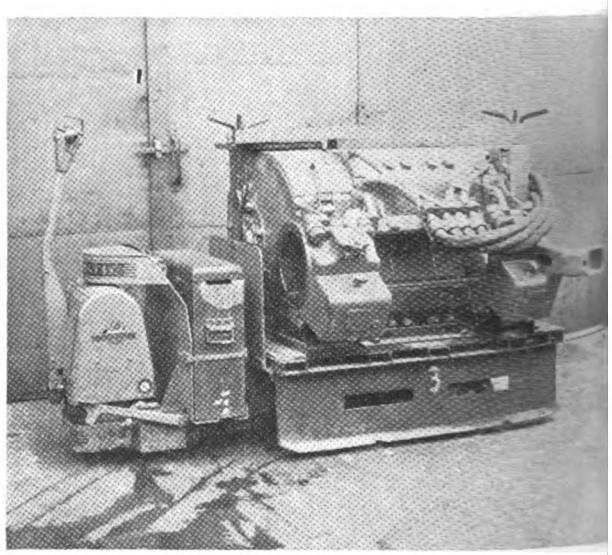
The skid, which is 14 in. high, 35 in. wide and 52 in. long, consists of a bed plate on two 12-in. channels. The motor is placed between angle irons which are secur to the deck or bed plate of the skid. Two of the angl are welded to the deck and the other two are secured wi cap screws. Holes for the cap screws are drilled in t angle irons and in the deck, there being one set of hol in the deck for each size motor. Nuts, aligned with t holes, are tack-welded to the under side of the deck a the holding cap screws are threaded into these nuts.

The motor is held down by two straps hinged to ea side of the skid and a cross bar consisting of two cha nels welded back to back. Each hinged strap is term nated in a threaded rod fitted with a wing nut or pair handles 8 in. long which eliminate the need of a wrenc When the motor is placed on the skid, the hinged stra are lifted to a vertical position on each side of the moto their ends run through holes in the cross bar and t wing nuts applied and tightened.

The skids with the motors are handled in the electr



Various size motors may be secured firmly to the skid and it may handled from the end by a lift truck or transporter and from the s by a fork truck



The skid with a motor in place on an Automatic transporter

shop with heavy-duty Automatic Transporters made b the Automatic Transportation Company, Chicago, t transporter being run under the skid from one end as illustrated. In other locations it is necessary to move them with fork trucks. This is provided for by slots cut in the sides of the 12-in. skid channels.

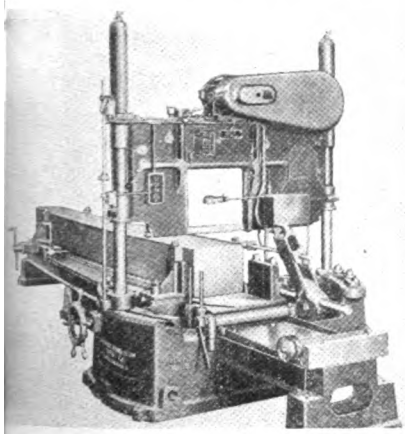
NEW DEVICES

Shop Tools and Equipment—Materials—Locomotive and Car Specialties

Roll Stroke Hack-Sawing Machine

The No. 18 Marvel universal hack saw, which has a minimum work-piece capacity of 18 in. by 18 in., employs an entirely new principle of blade reciprocation in its "Roll-stroke" movement. This machine, manufactured by the Armstrong-Blum Manufacturing Company, Chicago 39, is heavily built and reinforced to meet heavy work demands in locomotive shops, forge shops and steel mills. Heavy work is easily and safely moved in and out of the machine on a work track and dolly. Cut off pieces are safely supported on a discharge track and roller. All moving parts are fully enclosed as a safety measure and to prevent the entrance of abrasive dust and dirt.

The roll stroke movement employed puts only a relatively short length of blade in contact with the work at any one time. As a result, shorter chips are formed which do not clog the tooth gullet, chips are progressively eliminated from under the blade and required blade pressure is considerably reduced. Anti-friction bearings are used on moving parts and the blade



Heavy duty metal cutting machine

frame, of welded-steel construction, is carried on four roller bearings.

The hydraulic system used on the machine operates at low pressure. There is a range of blade speeds from 65 to 165 strokes per minute. The hydraulic pump is required to operate only during the intervals when the blade is being raised. This controlled feed permits cutting of light sections or pieces of full machine capacity rapidly. Miters can be cut by swiveling the entire main housing to any desired angle up to 45 deg. Protractor bands at each end of the table bed indicate the angularity of the cut which will be made. Safety stops are provided and, if blade tension is not sufficient or if a blade breaks or if feed pressure is excessive, the machine stops automatically and cannot be operated until the condition is corrected.

A one-shot oiling system is used to lubricate the entire machine. Blade coolant is delivered from four adjustable jets, mounted in the housing, which remain in the same position relative to the blade throughout the full vertical traverse.

Flue Welder

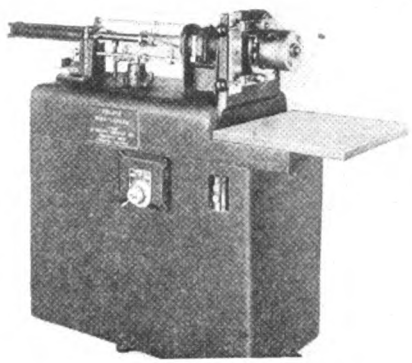
A flue welder with a productive capacity of from 30 superheater tubes per hour to 100 small tubes per hour and which may be provided with several sets of dies to take care of various size flues has been announced by the Thomson-Gibb Electric Welding Company, Lynn, Mass.

Push-up pressure is applied hydraulically with a long lever at the operator's right hand to provide a convenient control of platen travel. A push button operating a magnetic contractor current control is mounted on the pressure-control level. Air-operated clamps are controlled by levers at hand level in front of the dies. The water-cooled dies are vertically adjustable by hand wheels. A five-point heat regulator provides the one best welding heat for the power conditions in the individual shop.

The 150-kva. transformer is offset in the frame so that flash never touches the transformer core or coils. The slide bearings are set out at the ends well away from the line of the flash and the clamp operating mechanisms are shielded by flash-proof hoods.

Piston-Ring Lapper

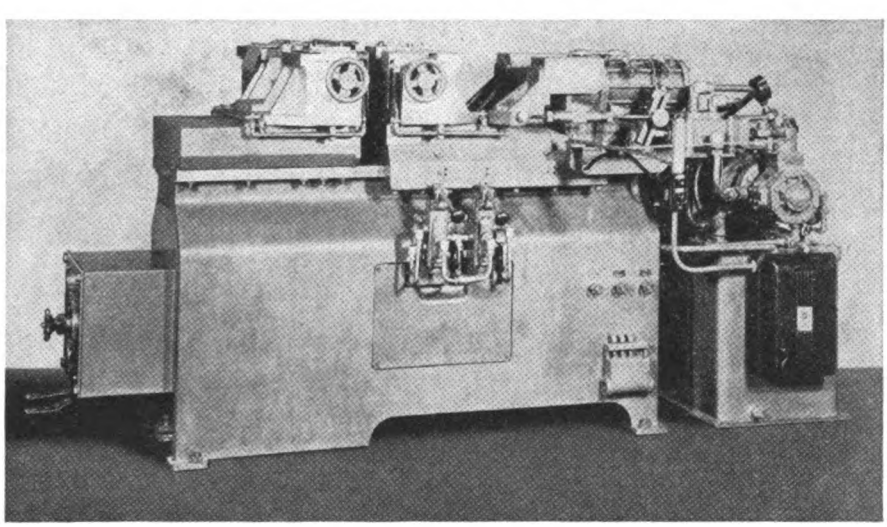
A piston ring lapper suggested for proper fitting of rings and cylinders in such equipment as air compressors, Diesel and gas



Lapping machine for fitting rings

engines, pumps, hydraulic cylinders, piston and triple valves, sealing rings, plungers and cylinders of fuel control valves, spray valves, fuel injectors and many other applications where perfect fit and minimum leakage are required, is being manufactured by the C. Allen Fulmer Company, 1237 First National Bank Building, Cincinnati 2, Ohio.

This machine has been engineered to give a half revolution of the spindle on a full outstroke, with no rotation on the return stroke. At each reciprocating cycle, the spindle "hunts" so that there is no possibility of the abrasive traveling over the same path during the next stroke of the lapping operation. The spindle operates



High-production flue welder

in a bath of oil and carries a wiper seal to protect it against dirt and grit. Stroke-setting stops can be set to give working strokes from 2 to 12 in. and a reset counter tells the operator the number of strokes for each operation.

The machine is equipped with a Vickers hydraulic pump and valves, with the pump driven by a 2-hp. motor. The tank, motor and valves are incorporated in the base of the machine, with ample room for getting to any part of the equipment as needed. Adaptor plates can be supplied to hold any size cylinder required, and the cylinders are locked in position with quick-action clamps. Steel lapping heads can also be supplied, for any engine, which do not require the rings to be opened up in putting them on or taking them off the head.

Plate Duplicator For Irregular Shapes

The Thomas Machine Manufacturing Company, Pittsburgh 23, Pa., announces the development of a plate duplicator built to overcome such wasteful practices as hand marking, hand positioning, and the use of two or three machines where coping, notching or different size holes are required in the working of a small number of shapes.

The duplicator comprises a deep throat punch with a solenoid control clutch, a template pin cluster connected by shafts to a punching tool head, and an all-steel table carrying rollers to support plates to be punched. Roller-bearing track wheels support the table, which is moved by pinions engaging track racks and controlled by a handwheel.

In operating, the plate and template are clamped to a heavy channel-section carriage. Using the handwheels, the operator moves the templet under the desired locating pin. By a foot-switch operating a solenoid, he forces the pointed locating pin down through the hole in the templet. This pulls the table into position under the punch, also operating the gag on the punching tool selected and engaging the punch by means of solenoid, and the punching is made. Holes can be punched diagonally or in any direction. As many as 11 tools including round, square and slotting tools, may be set in the punch. When shifting from one tool to another, a lever is thrown to select the tool is wanted.

An oscillating stripper is provided to hold light work where distribution might occur. Rollers on each side of the punch are spring mounted so the plate rides free of the dies. The duplicator has an accuracy of between 1/64 in. and 1/32 in. Holes as large as 6 in. in diameter and of any shape may be punched.

Diamond Grinding Wheels

J. K. Smit & Sons, Incorporated, 157 Chambers street, New York, has developed two diamond wheels of unusual shapes, one for a special form grinding job and the other for sharpening all types of multi-bladed cutters. The unusual shapes of these two

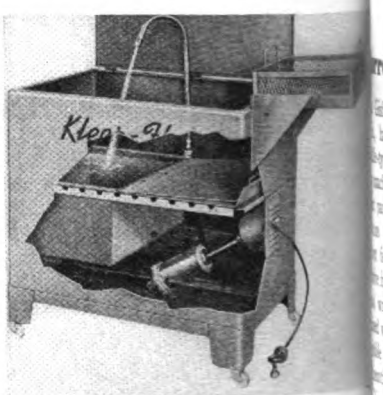
Diamond grinding wheels of special form

wheels provide maximum clearance with a minimum of contact area between wheel and work. With the diamond section mounted on the periphery of the core, only the inside of the core requires dressing the diamond section wears away. The co may be easily cut away with a dressing st

Type 660B, the shallow dish wheel, capable of grinding accurately and holdin form in the sharpest corners. Rigidity pr vided by a sturdily-built bakelite body a lows for the performance of delicate oper tions even at high speeds. It is availab in a 6 in. diameter. Type D11B, the flarin cup wheel, is designed for economical ge eral tool and cutter grinding. Maximu cutting efficiency is due, in part, to t rigidity of the solid body construction Various resinoid bonds are supplied to me the requirements of every type of grindi operation, BD bond for fine carbide-tipp reamer flute grinding, BC bond for inte mediate size carbide tipped cutters, a BV bond for larger cutters and heavy sto removal. It is manufactured in 3¼ a 5 in. diameters.

Metal Parts Cleaning Machine

A metal parts cleaning machine which c also be used for the cleaning of small el tric motors or other small assemblies manufactured and distributed by the Prac tical Products Company, Minneapolis Minn., as its Klear-Flo 30 model. The un has a 20-gal. capacity tank from which th cleaning compound employed is circulate by means of an electrically driven pu through a semi-rigid metal hose which c be adjusted to direct the flow of clean fluid in any desired direction. The circ lating pump is enclosed in a cast-



Small metal parts cleaning unit

housing and operates to eject heavy dirt a sludge from cleaning fluids before the enter the filter. Replaceable filter element are readily changed. The electric moto furnished is for 110-volt 60-cycle curren and is designed to be sparkless. It is fan cooled. Other motor types are also avail able.

The cabinet of the unit is of all-steel electrically-welded, gusseted construction and is made of 20-gauge steel with an enamel finish. The cover is hinged and is designed to protect against fire. The machine occupies a floor space of 24 in. by 36 in. and is mounted on casters so that it can be moved readily about a shop.

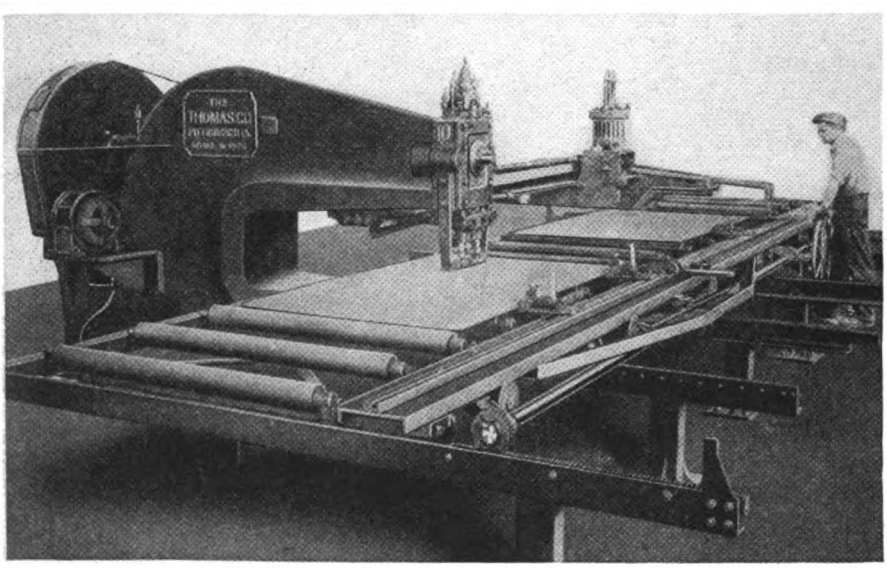
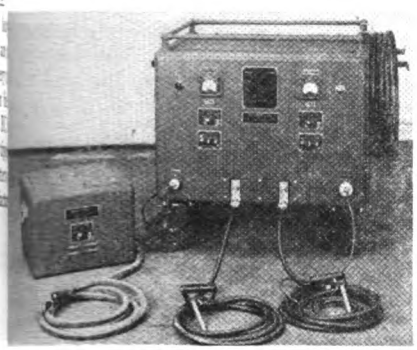


Plate duplicator intended especially for use on irregular shapes and short runs

Magnetic Inspection Unit

A unit for magnetic particle inspection, known as the KH-2 unit, has been introduced by Magnaflux Corporation, Chicago. It is particularly well-suited for the inspection of welds, castings, large forgings, and machinery parts. It permits detection of deep sub-surface discontinuities and enables an inspector to distinguish between lami-



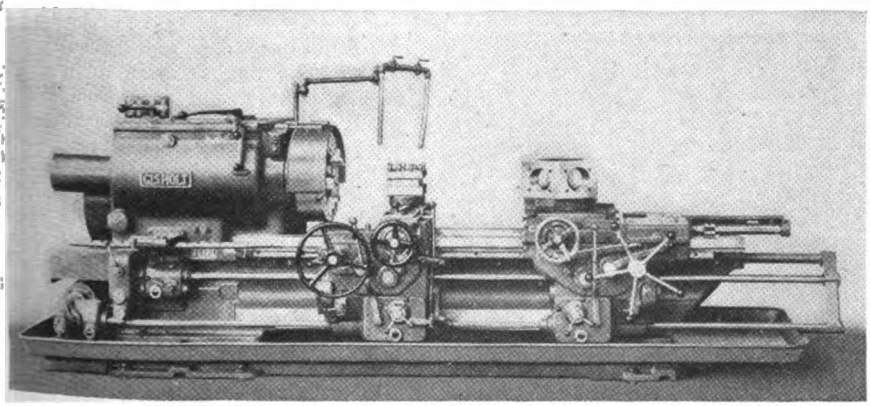
A mobile magnetic inspection unit for general shop use

nations and segregations in rolled plate. Welds designed with open roots can be inspected without interference of non-relevant indications. It may also be used to locate shrinkage cracks, hot tears, blow holes, porosity, etc., in castings; thermal cracks, lack of penetration and fusion, slag inclusions, and other discontinuities in welds; laps, bursts, cold shuts, etc., in forgings; and fatigue cracks in machinery parts.

Turret Lathe

The Gisholt Machine Company, Madison, Wis., has developed a high-production saddle-type turret lathe which is being used for machining operations on such replacement parts as locomotive rod bushings of various sizes, employing a cross-feeding turret feature with simple tooling; locomotive front and main crank pins and crosshead wrist pins of the larger sizes, machined with single-cutter turners and other suitable simple tools; taper bolts, and other locomotive parts.

This model known as the 3L, augments, through its larger capacity and specifications, the utility afforded by the somewhat smaller saddle-type machines and ram-type turret lathes made by the company. It has 4½-in. or 6-in. round bar capacity, 5 1/16-in. or 6¼-in. spindle bore, and 28½-in. swing. The 3L turret lathe is a much heavier machine than the model which preceded it, and is correspondingly rigid and sturdy. It embodies all the latest Gisholt design features intended to contribute to strength, versatility, operational ease, and long life.



Saddle-type turret lathe used in machining locomotive parts

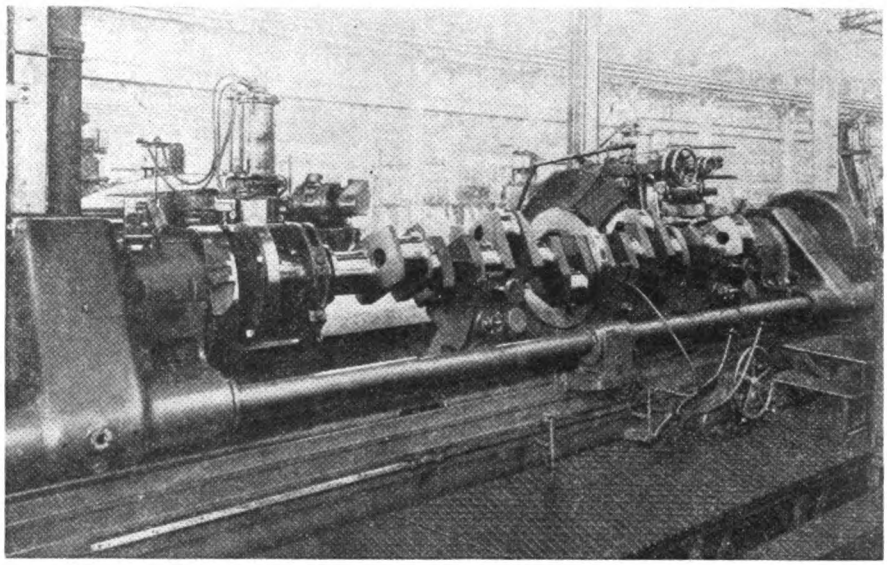
Hydraulic Crank-Pin Grinder

Crankshafts for Diesel engines which have a weight of up to 5,000 lb. and a maximum length of not over 230 in. can be ground on the 40-in. by 216-in. Type-B hydraulic crank-pin grinder made by the Landis Tool Company, Waynesboro, Pa. This machine incorporates most of the features of the Landis Type-B plain grinder with special changes made to adapt it for crank-shaft grinding.

The work heads and drive were designed especially for the handling of exceedingly large crankshafts. Of outstanding importance is the dual work-drive arrangement which eliminates or minimizes objectionable torsional deflection in the crankshaft. Power is transmitted from each work-drive motor through a combination multiple-vee belt and silent-chain reduction unit to a drive shaft extending along the entire front of the machine. The speed of the work-drive motors is synchronized electrically. A jogging handwheel on the drive shaft in front of each head enables the operator to rotate the work on the grinder readily in order to engage the fixture-aligning latches.

The work heads may be moved longitudinally on the work table, thus permitting them to accommodate shafts of varying lengths. Both work-head spindles are extra long and on the outer end of each a balancing weight may be adjusted on a slide as required. Work-spindle bearings are automatically flood-lubricated and have a bull's-eye gauge at the front of each head for the checking of the oil supply.

Throw blocks for crankshafts having



Diesel engine crankshaft grinder

varying end main bearing diameters are interchangeable. The top half is of the floating type so it can be used for final clamping purposes. Fixture-aligning latches are provided to hold the two work fixtures in alignment during loading and unloading. End-wise locating is provided for in accordance with the characteristics of the shaft being ground. It is usually against a stop on the indexing plate or against the side of the clamping block. Radial locating may be by means of a revolving indexing plate or a fixed stop plate.

A conventional work rest is used to support the shaft at each of its ends and a special rest is employed at the center main bearing. This latter rest is provided with an eccentric ring which may be slipped over the crankshaft from the end. There is a work-clamping arrangement in it. Inasmuch as the ring is eccentric in shape, it may be used for a variety of throws and interchangeable clamping blocks permit it to handle a variety of center main-bearing diameters. The ring revolves with the work and is supported by water-cooled lignum-vitae bearings held in a semicircular base.

A shoulder-grinding attachment is sup-

plied to grind crankshaft cheeks. It is particularly rugged and is not intended merely for slight truing up of the cheeks but for the rapid removal of as much metal as may be required. Control is by means of a hand-wheel to the right of the regular feed-up hand-wheel. Grinding may be done from either left to right or right to left; the amount of movement is ¼ in.

An electrical control desk, usually located facing the front center of the machine, gives centralized electrical control. There are push buttons for starting and stopping the various electric motors, and field rheostats for adjusting the speed of the adjustable-speed work-drive and traverse motors. Two ammeters enable the operator to determine accurately and quickly whether the crankshaft is perfectly balanced before he starts to grind. To simplify the operation of the machine further, all electric motors may be started and stopped from a second push button grouping at the front of the wheel base.

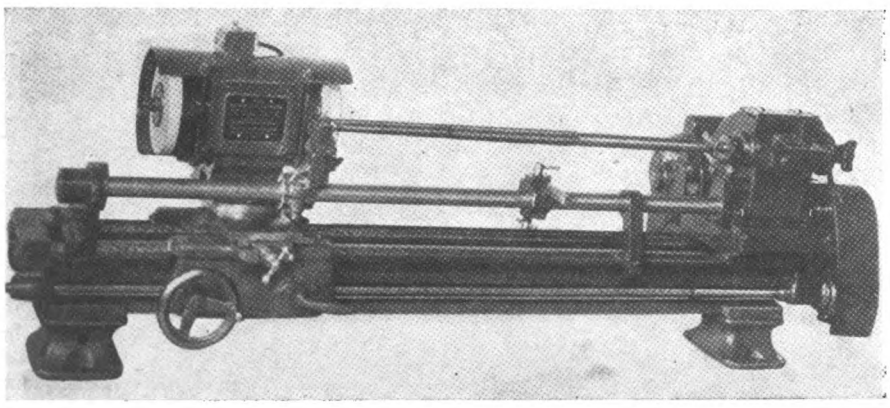
Tap Grinder

A tap grinder for sharpening staybolt taps, long taper reamers and other tools requiring relief grinding over long taper surfaces is announced by Edward Blake Company, 634 Commonwealth Avenue, Newton Centre 59, Mass. This machine is designated as Model No. 4 and is especially designed so that the side of a small wheel is fed along the taper of long taps, instead of having a wide wheel to cover the complete taper in one pass.

The work head is mounted on a lathe bed and the wheel head is mounted on the lathe carriage cross slide. The controls on the cross slide give longitudinal and cross feed motions to the wheel head. Staybolt taps and long taper reamers are held on ball centers. The tailstock center can be moved off center any desired amount so that the flutes remain parallel to the grinding wheel. Any desired relief can be obtained by a simple setting, and any right- or left-hand tap, up to 43 in. long with 2, 3, 4, 5, 6, 8 or 10 flutes can be sharpened.

Rotation of the work is automatic. This is accomplished with a separate motor mounted behind the work head which revolves the work through a train of gears. The gears may be disengaged easily for hand operation. Power longitudinal feed for the wheel head is obtained by engaging the lead screw on the carriage. A locating device sets the tap flutes in the proper grinding position. A wheel truing device is also provided. It may be positioned anywhere along the pivot bar, and, after being locked, the wheel is fed past the diamond for truing.

The No. 4 machine is regularly supplied with two 110-volt, 60-cycle, single-phase, a. c. motors and two 80-grit, ¾-in. face, 6-in. diameter grinding wheels.

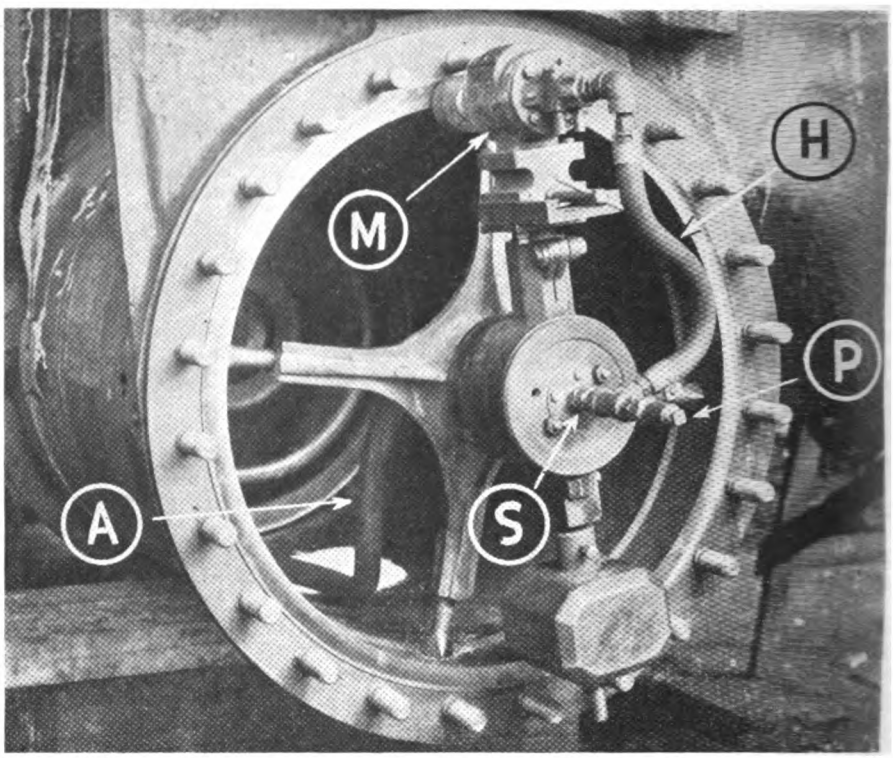


Grinder for sharpening long taps

Cylinder-Joint Grinder Improved

The portable, rotary, surface-grinding machine, developed by the R. J. McQuade *Engineer*, has recently been improved by substituting a more powerful air-motor drive for the ½-hp. electric-motor drive formerly used. The new air motor is of the Thor centrifugal type, made by the Independent Pneumatic Tool Company, and delivers 1½ hp. at 6,000 r.p.m., the free speed being 8,000 r.p.m. It is direct-connected to a 2½-in. cup-type grinding wheel which refinishes the joint surface as the rotating arm is slowly revolved by hand around a center post supported by a spider in the end of the cylinder. Infeed of the wheel is provided by means of hand-feed screw.

The greater power of the air-motor drive permits taking heavier grinding cuts without danger of stalling the motor, and grinding time is proportionately reduced. In an actual test, the machine was set up in the

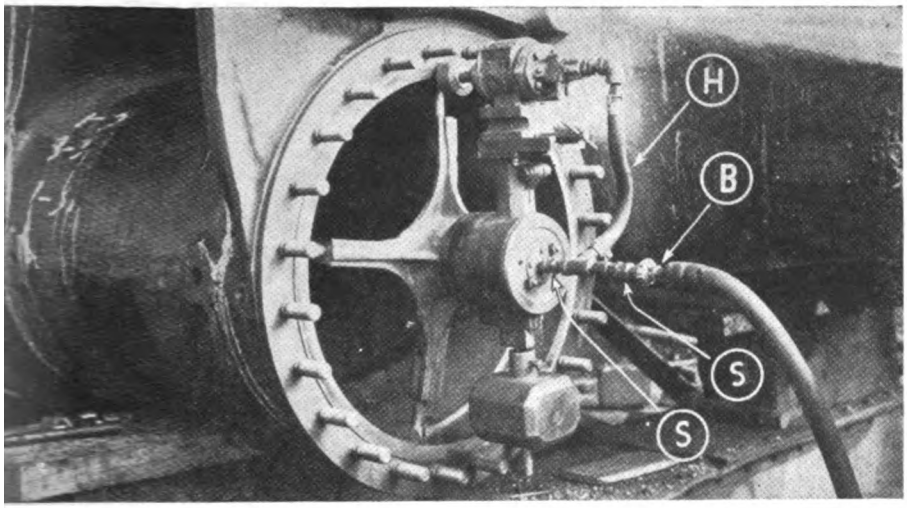


McQuade cylinder-joint grinder equipped with new Thor 1½-hp. air motor—With piston removed, air connection is made through the back of the cylinder, as shown in this illustration

Company, Chicago, for refinishing steam-locomotive cylinder joints, as described in the May, 1942, *Railway Mechanical Engineer*, has recently been improved by substituting a more powerful air-motor drive for the ½-hp. electric-motor drive formerly used. The new air motor is of the Thor centrifugal type, made by the Independent Pneumatic Tool Company, and delivers 1½ hp. at 6,000 r.p.m., the free speed being 8,000 r.p.m. It is direct-connected to a 2½-in. cup-type grinding wheel which refinishes the joint surface as the rotating arm is slowly revolved by hand around a center post supported by a spider in the end of the cylinder. Infeed of the wheel is provided by means of hand-feed screw.

The greater power of the air-motor drive permits taking heavier grinding cuts without danger of stalling the motor, and grinding time is proportionately reduced. In an actual test, the machine was set up in the counterbore of a 26-in. steel cylinder, with cast-iron bushing, the spider centrally located and the grinding wheel adjusted radially so as to just clear the studs, which need not be removed when using this particular type of machine. The total set-up and adjustment time was 30 minutes and the grinding time necessary to produce a smooth, accurate seat for the full width of the bearing surface was 30 minutes, or a total of 60 minutes. This may be compared with 30 minutes set-up time and about 90 minutes grinding time, or a total of 120 minutes, formerly required with the electric grinder on a cast-iron cylinder of the same size. In this comparison, the air-motor drive is penalized to a certain extent, since the machine was working on a steel cylinder which is tougher material to grind than cast iron.

A simple piping arrangement permits either of two air connections to be made to the cylinder-joint grinder, as now

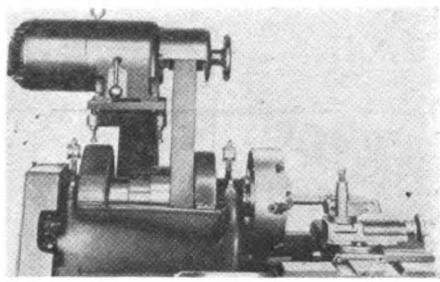


Air supply to the McQuade cylinder-joint grinder when the piston is not in the cylinder

equipped with air-motor drive, dependent upon which is more convenient for the operator. If the piston is out of the cylinder, the shop air hose is inserted in the cylinder from the back, as shown at *A* in one of the views, and coupled to a ⅜-in. pipe connection which passes through the center-post to the front of the machine and thence upward through a ½-in. flexible rubber hose *H* to the air-motor *M*. Outer end *P* of the air line is plugged and a pipe swivel *S* between the ⅜-in. tee and the cover plate permits the tee and air hose to rotate as the machine is used. There is sufficient slack in hose *H* in conjunction with three different motor extensions, supplied with the machine, to permit grinding cylinders from 22 in. to 32 in. in diameter and one special machine has been built for a railroad to grind 39-in. cylinders.

The piping arrangement described leaves the machine operator entirely unhampered by interference with the shop air hose. In case the piston is in the cylinder, the inner end of the air-supply line is simply plugged and the shop air hose connected to the outer end, as shown at *B* in the other view. Two swivels, *SS*, one on either side of the ⅜-in. tee, permit the tee and air-motor hose *H* to rotate without winding up or twisting the shop air hose. Even with this arrangement the shop hose does not interfere in any appreciable way with the operator.

with a lever conveniently located for the machine operator's use. Direct-connected



Gearshift drive unit applied to an engine lathe

drives are furnished with drip-proof motor frames to prevent damage caused to motors by flying chips or dripping.

Multi-Production Lathe

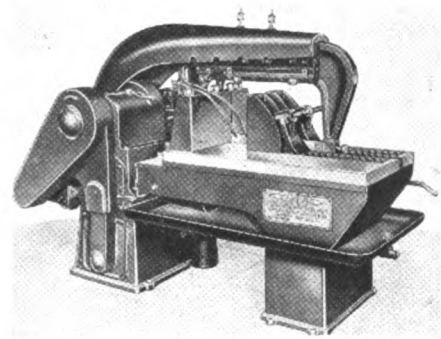
A semi-automatic lathe designed and equipped to machine duplicate shafts, which is intended for railroad shops where shafts are not produced in sufficient quantities to justify the set-up time required by the automatic lathe but are produced in large enough quantities to make the production afforded by the standard engine lathe too costly, is produced by the American Tool Works Company, Cincinnati 2, Ohio. Users report that it pays to set up multi-production lathes for lots containing as few as four pieces.

Multi-production lathes are equipped to use cemented-carbide cutting tools to the limit of their efficiency. They have the power, the range and the duplicating equipment to insure effective use of these high-speed cutting tools. The duplicating equipment provides the further advantage of eliminating time loss required for measuring and calipering and of reducing spoiled work to a minimum.

An advantage in versatility over the automatic lathe is offered by the multi-production lathe. By retaining all of the standard engine-lathe features it provides the same adaptability and range as the standard engine lathe while in addition through its combination of automatic length stops, positive diameter stops, direct measuring cross feed dials with indicating clips, and special multiple tooling, it offers in a very high degree the productive advantages of the automatic lathe.

Heavy-Duty Hydraulic Metal-Cutting Machine

The Racine Tool & Machine Company, Racine, Wis., has in its line two heavy-duty metal-cutting machines developed especially for the cutting of solid bars of large



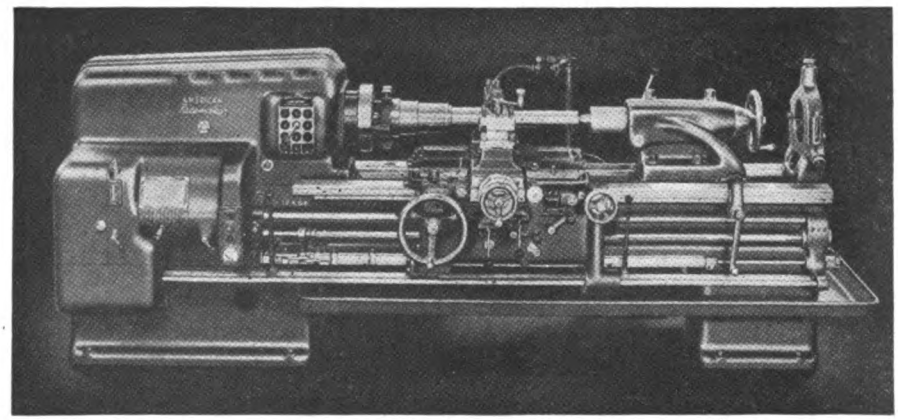
Metal-cutting machine designed for heavy work

dimension stock. They may also be used for the cutting of large tubing, structurals, tough alloys, forgings, castings, die steels

Gearshift Drives For Machine Tools

Gearshift drives made in sizes from ½ hp. to 25 hp. which are available with motors having various speed ratings are manufactured by the Chicago Railroad Supply Company, Chicago 4, for practically all machine tools. These gearshift drives, either with direct motor drive or belt drive, are furnished as standard equipment with four forward speeds. A reversing-drum control can be furnished which will give four reverse speeds also.

When provided with two-speed motors the units have a total of eight forward and eight reverse speeds. Gear shifting is done



A semi-automatic lathe which produces duplicate pieces

and all classes of non-ferrous metals. The Model 40-C which is illustrated has a capacity of 14 in. by 20 in.; the 41-C has a capacity of 20 in. by 20 in.

A positive progressive feed is provided for cutting tool steel and tough alloys. A flexible feed allows the saw blade to move rapidly in small areas of stock and when cutting through the light-walled section of tubings, structurals and shapes. All feeds are controlled through a graduated feed dial. Constant hydraulic pressure applies the feed and controls other operating functions. A single lever operates the controls.

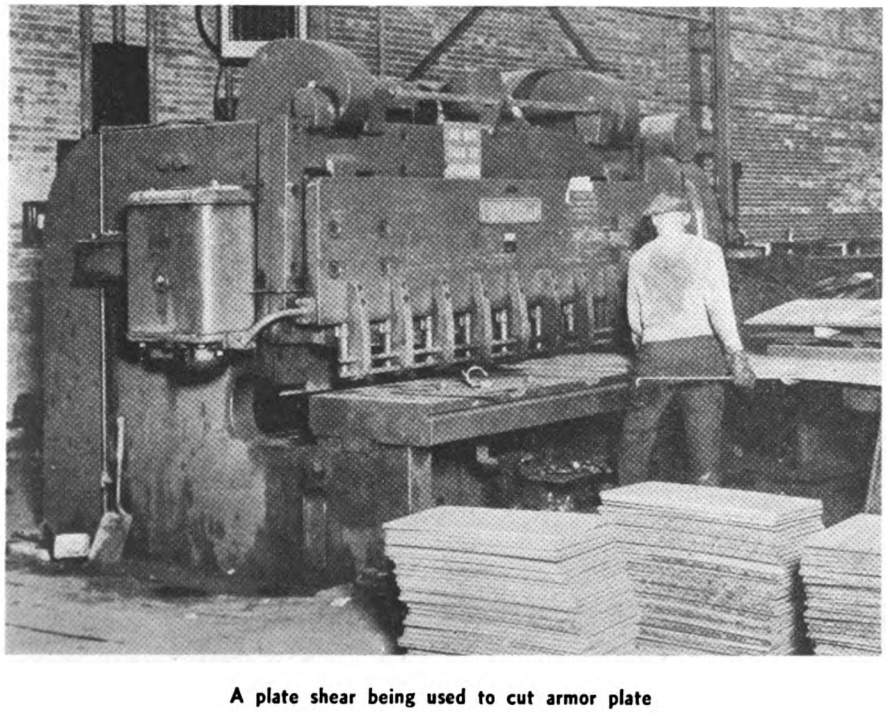
The machines are driven by a 3-hp. motor through five vee belts and an hydraulic twin-disc clutch connected to a three-speed transmission. Belts and pulleys are fully guarded. The table plates and steel wear plates on the vise jaws are replaceable and a swiveling vise can be furnished if needed.

Plate Shears

Plate shears of all-steel construction are offered by the Cincinnati Shaper Company, Cincinnati, Ohio, for use in shops having sheet or plate cutting work such as is encountered in railroad boiler and car shops. The shears are designed as precision tools and are equipped with single control, back-gauge, adjustable stainless graduated scales in the work table and with front gauges having extension arms. The accuracy of cutting is said to be such that micrometer measurements are needed to detect variations in cut sections.

The shears are furnished with four-edged knives as standard equipment which give four cutting edges on each knife before regrinding is necessary. Hydraulic holddowns are used; these deliver a heavy uniform pressure along the full length of the working table and serve to prevent slippage of work even when there is a variation in plate thickness. The holddowns are a series of independent plungers actuated by oil pressure, spaced from end to end on 12-in. centers. All plungers exert a uniform pressure regardless of the amount of their movement and the pressure developed by a single plunger is sufficient to hold in place any small work which is to be cut under it.

The general design of the machine frame and the operating mechanism and drive is similar to that of the press brakes also manufactured by this company.

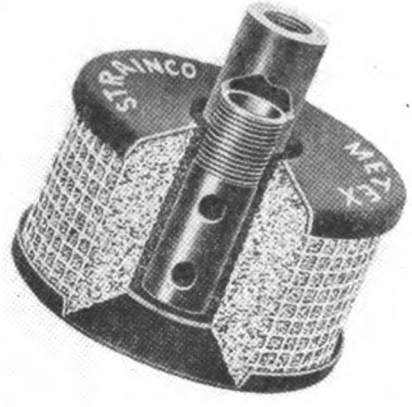


A plate shear being used to cut armor plate

Strainer for Machine Tools

A non-clogging industrial strainer for use with turret lathes, screw machines, grinders, and all other machine tools that employ a cutting oil or coolant is manufactured by the Strainer Products Corporation, 75-77 North Willow Street, Montclair, N. J., under the trade name of Strainco-Metex. The units have a long-period capacity for dirt, chips and grit. Strainer refills are easily installed and old ones can be washed and made ready for re-use in a matter of minutes. The efficiency of the strainer prevents metal cuttings and chips from lodging in the pump, and reduces the time required ordinarily for pump cleaning.

The units are supplied in types, sizes, and capacities adapted to every size and type of machine tool. Manufactured of fabric and wire strands knitted into a honeycomb construction, the mesh is designed into non-collapsible strainer units of high capacity and large strainage area.



Strainer for cutting oils or coolants used in shop machining operations

Hard-Facing Welding Rod

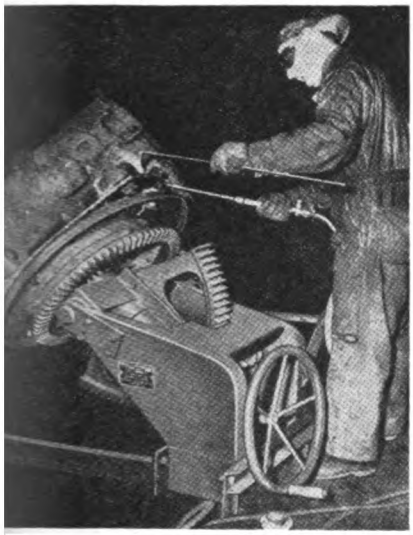
The Eutectic Welding Alloys Company, 40 Worth Street, New York 13, has introduced into its line of products a new hard-facing alloy rod which, when applied by either the oxyacetylene or electric-arc welding processes, gives readings on the Rockwell C scale of from 58 to 63. The new alloy is available in two qualities, as EuteChrom 13 for oxyacetylene application, and as EuteChrom 130 which is the same alloy with the addition of special shielding for arc welding with both a.c. and d.c. current. A special flux is used with EuteChrom 13 when applying it on steel and an acetylene excess is required. In applications on cast iron, an oxygen excess is employed. The alloy is said to deposit readily on cast iron and all types of steel. At present the rod is furnished in only ¼-in. and 3/16-in. sizes.

Screw-Type Electrode Holder

A screw-type electrode holder, one-third lighter than its corresponding size clamp-type holder, has been announced by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis. Exposed metal surfaces of the holder are constructed of spatter-resistant Mallory metal. Simplified design facilitates easy replacement of parts, and heavy insulation and adequate handle ventilation assure cool operation. It is available in light and heavy duty sizes to accommodate electrodes up to 3/8 in. diameter.

Work Positioners

The positioning equipment manufactured by the Ransome Machinery Company, Dunellen, N. J., usually thought of in connection with positioning work for welding, is proving useful in railroad shops for positioning distributor and feed valves, lubricators, condensers, feedwater pumps, cylinder heads, driving boxes, crossheads and other parts for shop operations. These include assembly, overhauling, chipping, grinding and drilling. Positioners range from 100-lb. hand-operated bench models and 500-lb. motor-operated models to 20-ton motor-operated units. All motor-operated models are equipped with constant-



elding positioner which can be employed usefully in other shop operations

variable-speed drives for rotated positioned work and the table tops have a lting range of 135 deg.

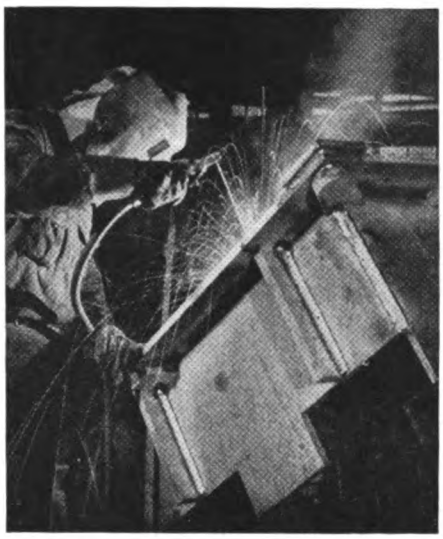
Duplex Rotary Surface Grinder

he Hanchett No. 24 duplex rotary surface grinder, a product of the Hanchett anufacturing Company, Big Rapids, ich., has fingertip control incorporated to the machine for separate operation of s two rotary work tables. The machine equipped with two magnetic chucks inended to eliminate much of the downtime equired for cleaning and reloading. Two irect-current motors, attached to the nderside of the carriage, drive the magetic chucks at variable speeds and are conolled from push-buttons centralized within stant reach of the operator.

A 25-hp. 900 r.p.m. motor of the built-in ype is used to run the grinding wheel. ine finishes are obtained with segmentalype grinding wheels. Other equipment inludes two 30-in magnetic chucks, an 18-. segmental wheel chuck fitted with a set f grinding segments, necessary small motors and controls for head feed and carriage traverse, two drum-type demagnetizing switches, an ammeter for the wheel motor, a flood light, a wheel dresser, and a wet grinding system including two motor-driven coolant pumps and tanks.

Electrode For Heavy Work

A heavily covered arc-welding electrode for flat and horizontal fillet welding as well as for flat butt welding has been announced by the Electric Welding Division of the General Electric Company. Designed for



The GE type W-27 arc-welding electrode being used on a steel machine base

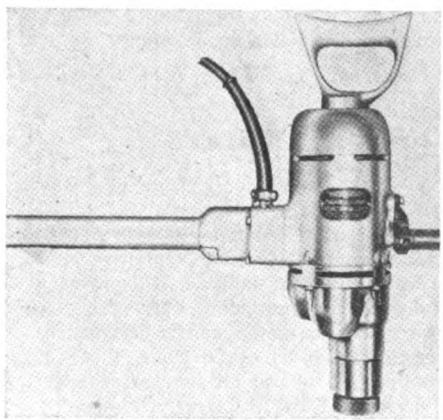
weld requirements which include high mechanical properties, rigid X-ray examination, good profile, high deposition rate, and good surface appearance, the applications of the electrode include pressure vessels and pertinent connections, heavy machine bases, and structural parts such as column plates, columns, roof trusses, beams and girders where the thickness of the section permits.

Known as type W-27, the electrode is characterized by a high melting rate which permits increased production and higher speeds at the same welding current as other electrodes. At comparable production speeds, it requires less heat input to the joint, thus reducing warpage and internal cooling stresses.

The electrode operates on alternating current or direct current with either straight or reverse polarity. It has low spatter loss and easy slag removal and produces welds of good appearance. It is available in three sizes: 3/16 by 18 in., 1/4 by 18 in., and 5/16 by 18 in., and is rated A.W.S. classes E6020 and E6030.

Portable Ball-Bearing Drill

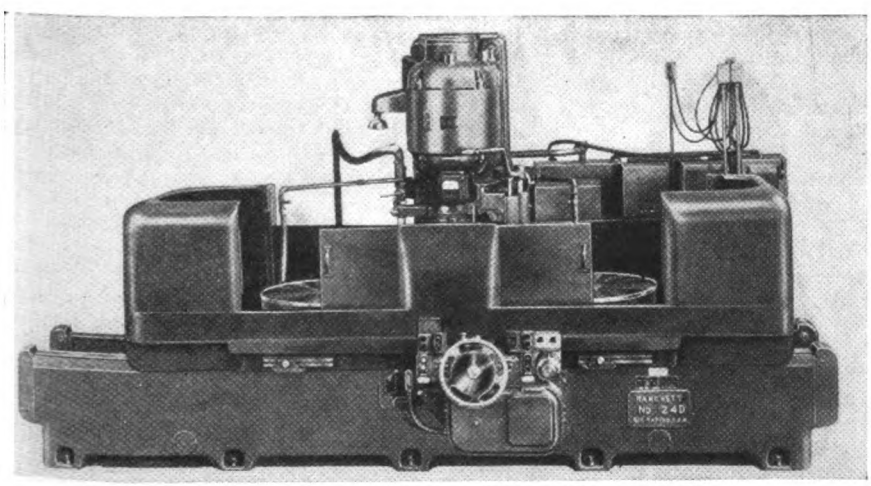
A large and powerful electric motor-driven drill, produced by the Black & Decker Manufacturing Company, Towson, Md., has a drilling capacity in steel for holes ranging in size from 1/8-in., using a suitable reducing sleeve, to 1 1/4 in. with its standard chuck. The motor housing is cast with an adapter pad which permits the drill to be fastened to a drill stand if desired; for hand use it employs a spade handle and



Heavy-duty electric drill

a pipe handle. The tool can be used for light reaming up to a 1-in. diameter hole and for heavy reaming up to 3/4 in. Under full load it has a spindle speed of 160 r.p.m.

Standard voltage for operating a universal motor is 110 but units using 220 or 250 volts can be furnished. In addition, although the standard no-load speed rating is 250 r.p.m., the drill can be furnished with no-load speeds of 350, 600, 800 and 900 r.p.m.

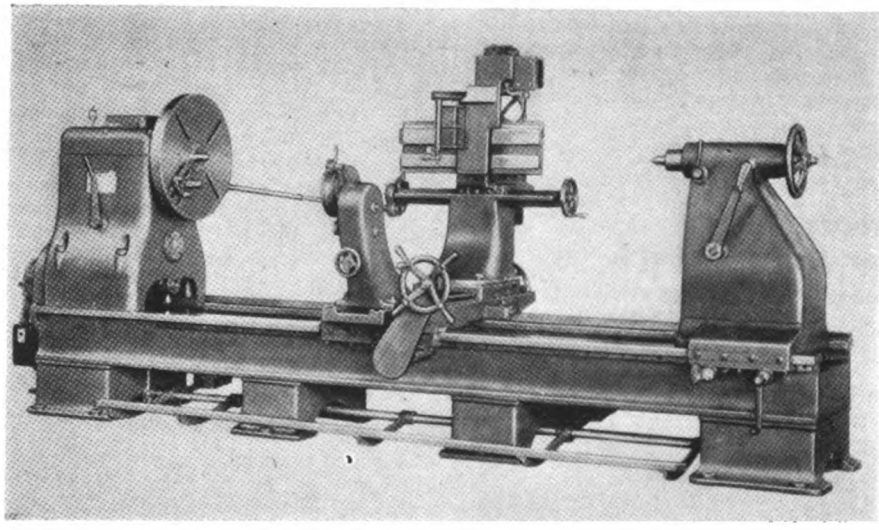


Duplex surface grinder equipped with magnetic chucks

Heavy-Duty Armature Machine

A heavy-duty armature machine developed by the Electric Service Manufacturing Company, Philadelphia, Pa., is capable of banding armatures up to 45 in. in diameter having shafts up to 96 in. long, and allows a 47-in. swing for the carriage. The tension device will travel or feed to within 4 in. of the headstock centers and 8 in. of the tailstock centers.

Two selective mechanical speed changes are provided, giving speeds ranging from 11 to 80 r.p.m. It is possible to grind and



Armature machine with commutator slotting attachment and banding device in position

true commutators 30 in. in diameter with lengths up to 19½ in. The tension device will handle steel or bronze wire of No. 10 B&S gauge at any tension up to 500 lb. The commutator under-cutting attachment will service commutators from 5 to 30 in. in diameter and 19½ in. in length.

Vertical Motors

The Crocker-Wheeler Division of Joshua Hendy Iron Works, Ampere, N. J., has announced an addition to its line of protected-type a. c. motors, consisting of a vertical drip-proof motor. It is rated at 40 deg. C rise continuous duty with a 15 per cent service factor and is designed for operation from 60 or 50 cycle, three- or two-phase circuits at all standard voltages. At present NEMA B flange type mountings up to and including the 284 frame, and NEMA C face type mountings up to and including the 326 frame are available.

All ventilating openings of this new line of motors are shielded against the entrance of dripping liquids and falling particles. Oversize ball bearings are provided which carry thrust in addition to the rotor and centrifugal bearing seals permit the use of softer grease for better lubrication and longer bearing life.

A recessed junction box allows ample room for making electrical connections. Rotor bars, fans and end rings are cast in one operation from aluminum alloys. The frames are of cast construction and coils are protected with Vinylastic insulation.

Drip-proof construction, cast rotor bars and Vinylastic insulation are used to insure uninterrupted service

Low Brightness Fluorescent Lamp

The General Electric Lamp Department, Nela Park, Ohio, has announced a low brightness 40-watt, 4,500-white fluorescent lamp in the 100-watt lamp size. It is designed to produce good quality illumination without the need for the same amount of accessory shielding as is required for standard fluorescent lamps.

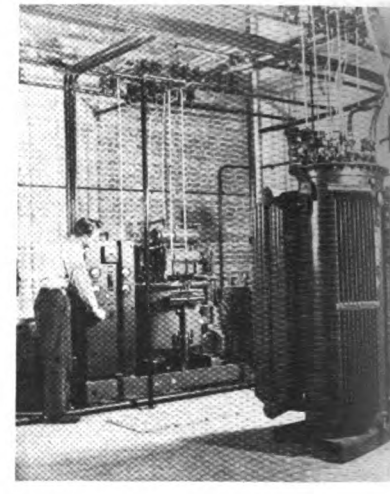
Giving relatively low brightness, reduction in shielding can be accomplished without an appreciable or corresponding increase in glare. A starting stripe, running lengthwise along the tube of the new lamp, facilitates starting. The lamp is suitable for use under any condition of humidity normally encountered. For most uses, longitudinal shielding only will be needed.

The 40-watt lamp in a bulb normally used for the 100-watt lamp has slightly more than one-half the brightness of the standard G-E 40-watt, 48 in., T-12 white fluorescent lamp. It is instant starting; has mogul bi-pin base; shorted base pins; standard mogul bi-pin lampholders, and is used with regular instant starting ballasts designed for 40-watt lamps. Preheat 40-watt ballasts may be employed with the new SS-400 "Jack Rabbit" split-second starter when available. Rated initial lumens are 2,000.

Converter For Induction Heating

A mercury-arc converter for the low-frequency range of electronic equipment required in induction heating applications has been announced by the Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Designed for electronically changing power at commercial frequencies of 60 or 25 cycles into 1,000- to 2,000-cycle power,



Mercury-arc converter for low-frequency induction heating

the frequency changer is suitable for supplying power for forging, melting, and metal-treating applications where large masses of metal or metal parts must be efficiently heated with this power at kilowatt capacities of 250, 500, 1,000 and higher.

Two applications of the converters have been made in the past year, one being a 300-kw. unit in a forge plant, and the other a 250-kw. unit in use in the melting section of a brass foundry.

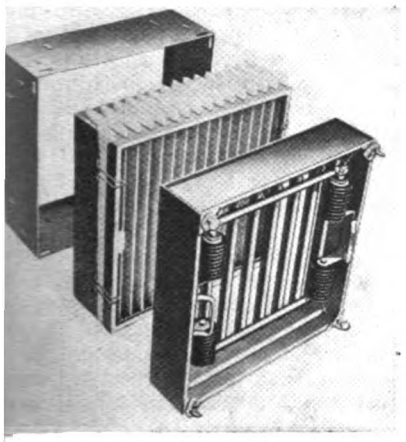
Electronic Air Filters

A recent addition to the line of electronic air filters made by the American Air Filter Co., Inc., Louisville, Ky., is the Electro-Airmat in which the collector element is electrostatically charged Airmat paper. Weighing 40 per cent less than electronic filters having metal plate collectors, the Electro-Airmat has an arrestance rating of 90 per cent or better with atmospheric dust and smoke.

Airmat is a cellulose product composed of a number of plies of porous, tissue-like sheets formed of short cellulose fibers in "jack-straw" arrangement. When an electrostatic charge is applied to the pack the plies tend to separate and each individual fiber becomes a collecting electrode which attracts and holds the dust and smoke particles. It is also a mechanical filtering media and affords protection against the infiltration of dust through air conditioning systems of railroad coaches placed on sidings or when the power is off for any other reason.

Ease of installation and economy are

ıvenience of maintenance are features imed for the Electro-Airmat. The power :k which furnishes the voltage for the er operates on 110-volt 60-cycle single- ıse current. Total power consumption approximately 220 watts at 110 volts, luding transformer losses in the power k. When the filter has accumulated its t load, it is removed and replaced with

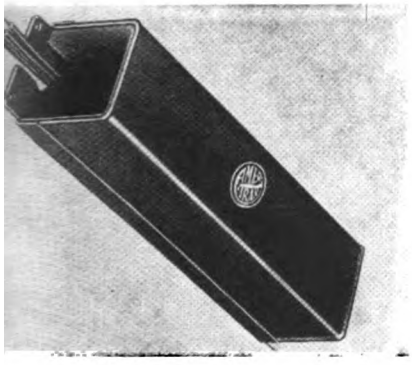


The three essential parts of an Electro-Airmat filter

an material by turning a crank in a chanical loader which automatically folds paper into the serrated base section the filter unit. Spare cells loaded with an filters can be provided at convenient minal points.

allasts for luorescent Lighting

ıe American Transformer Company, ewark, N. J., has introduced a line of llasts for hot- and cold-cathode fluores- nt lighting. The manufacturer claims for e ballasts an exceptionally close matching ith tube characteristics, assuring maxi- um lamp life and maintained brightness. is also claimed that flicker, end-blacking d premature burn-outs are reduced.



ıe ballasts will fit all standard fixtures and e suitable for interior or exterior channels

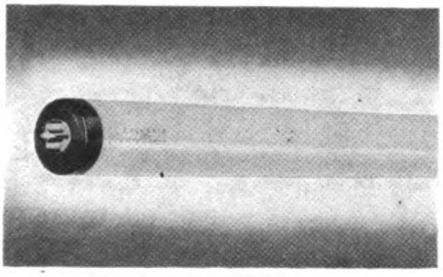
eing quiet in operation they are recom- ended for installations where the noise vel is low.

The ballast has a roll-turn lead-out that revents strain on lead insulation and facili- tes wiring. Since this lead-out is of the two-way type, it may be attached to exterior or interior channels, thus reducing the number of ballasts which need be stocked. Their dimensions make the ballasts adaptable to all standard fixtures.

Cold-Cathode Lamp

Introduction of a cold-cathode K lamp has been announced by Sylvania Electric Products, Inc., Salem, Mass. The lamp, which will be made in both 72 in. and 96 in. lengths of T8 (1 in.) diameter, will be instant starting and will have a rated life of 10,000 hours. On and off operation will have virtually no influence on reducing the life of the lamp.

The base of the K lamp employs a special contact pin which fits into a lampholder punched with a hole of similar design. The variation in the design of the base was made to prevent the LS type fluorescent lamp from being inserted in a circuit designed for the K lamp, or cold-cathode type of ballast, as the two lamps have different starting and operating characteristics. The lamp is especially adaptable for installations where maintenance is either difficult or costly.



A special base avoids the possibility of applying an LS type lamp in a circuit designed for cold-cathode operation

High-Tensile Steel

Otiscoloy is a high-tensile steel manufactured by the Jones & Laughlin Steel Corporation, Pittsburgh 30, Pa.

Excellent welding and forming characteristics are claimed as important features of this steel which may be hot-formed or cold-formed. Hot forming may be done without affecting its inherent properties. Its cold formability is only slightly less than that of ordinary low-carbon steels and the bending radius can be safely taken at twice the thickness of the material without encountering difficulties. It is also capable of performing satisfactorily in moderately severe drawing operations. The usual careful shop procedure employed in welding low-carbon and medium-carbon steels is said to produce stronger and more ductile welds in this steel. No excessive hardnesses are obtained and no brittle zones develop adjacent to the welds.

The steel is said to be corrosion and abrasion resistant. In sheet and strip form as well as in plate from $\frac{3}{16}$ in. to $\frac{1}{2}$ in. in thickness, its physical properties are:

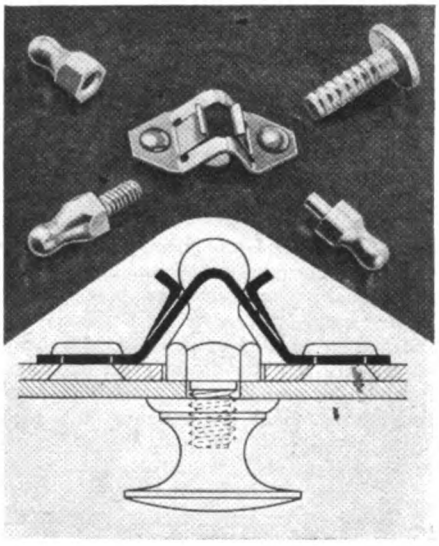
Tensile strength, min., lb. per sq. in.	70,000
Yield point, min., lb. per sq. in.	50,000
Elongation in 2 in., min., per cent	25.0

These values are slightly less in plates over $\frac{1}{2}$ in. in thickness.

The physical property values are subject to some adjustment depending upon requirements of specific applications. Those given are typical values.

Spring-Steel Latch

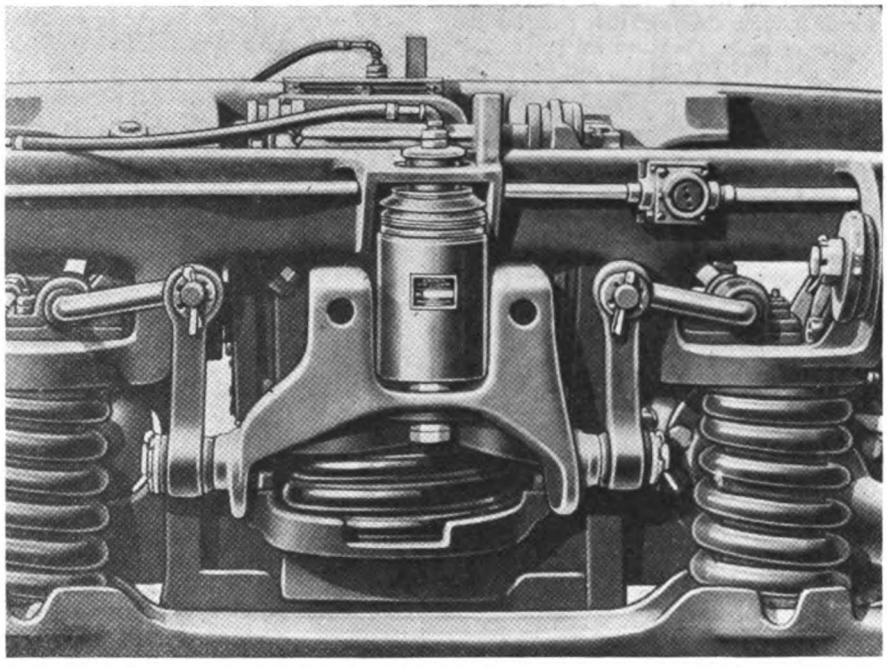
A spring-steel speed-nut latch has been developed by Tinnerman Products, Incorporated, Cleveland 13, Ohio, for instant attachment and removal of box covers, access doors, panels and inspection plates. Spring arms of the speed nut snap over ball or grooved studs to provide firm attachment, yet studs may be withdrawn quickly. It is available in five degrees of pull-out tension. Three styles of ball studs are available: drilled and tapped for 6-32 screws; threaded shank with a 6-32 thread; and, plain shank for riveting. They are furnished in various lengths to suit application requirements.



Parts and application drawing of speed-nut latch

Hanna Glide-Ride Air Cylinder

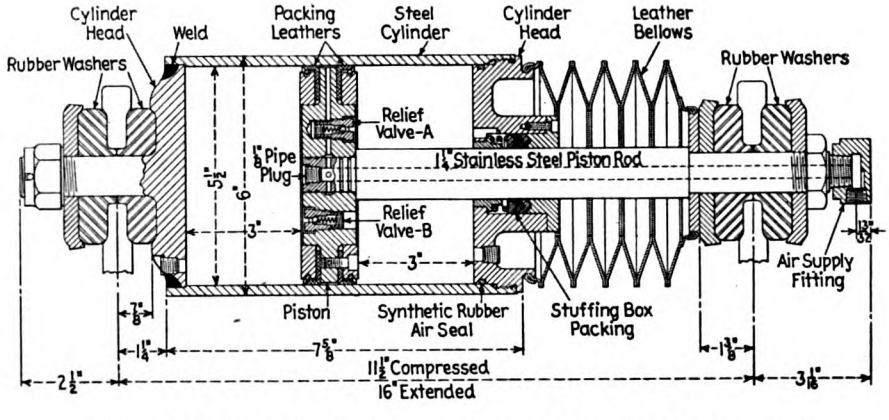
A cushioning device, designed for use on passenger-car trucks in high-speed service, has been developed by the Hanna Engineering Works, Chicago, and is known as the Glide-Ride air cylinder. Flexibly connected between the truck bolster and the main frame, this cylinder (two per truck) operates on compressed air taken from the signal line through a $\frac{1}{32}$-in. restricted opening and utilizes an ingenious patented piston construction which permits the truck springs to function freely under light road shocks, but builds up pressure rapidly and supplies an effective air cushion to supple-



Hanna air cylinder installed between truck frame and bolster to give smooth riding in high-speed passenger service

ment spring action as required under heavier shocks.

Being double-acting, the cylinder also cushions rebound and, with one cylinder installed on each side of each truck, car sway on curves is minimized and cars permitted to negotiate the rougher sections of track more smoothly and at higher speeds than would otherwise be possible. An adaptation of this cylinder is also being developed for use in a cross-horizontal position between the rear truck frame and the spring plank to minimize the whip



Cross-section showing details of construction of Hanna Glide-Ride air cylinder

action of observation car ends while passing curves at high speed. In preliminary road service tests of one car set of these air cylinders on a Chicago, Milwaukee, St. Paul & Pacific passenger car which has made about 150,000 miles in the last year the cylinders functioned as intended and received no mechanical attention other than occasional inspection.

Referring to the drawing, the construction of the Glide-Ride air cylinder and piston will be apparent. The cylinder consists of a 5½-in. seamless-steel tube with a steel head welded in the lower end and the upper head screwed in place, with a synthetic rubber gasket to prevent any possibility of air leakage. The built-up piston has a travel of 4½ in. in this cylinder and is constructed with two spring-supported packing leathers; annular ports lead from the center of the piston to the cylinder walls between the packing leathers; and two spring-loaded relief valves usually set for 100 lb. admit air through a ⅛-in. port hole above each ball check and pass it through a 1/32-in. hole in the plug at the other end. Valve *A* thus passes air in excess of 100 lb. from above the piston back into the air-supply line at the piston center. Valve *B* simply passes excess air from below to above the piston. The stainless-steel piston rod, suitably packed to prevent leakage of air through the stuffing box, is hollow bored and takes air from a special fitting and 1/32-in. orifice in the air-signal supply line and delivers it to the center of the piston. The leather bellows, illustrated, protects the piston rod against dirt and moisture. Necessary flexibility in attachment of the cylinder between the bolster and truck frame is secured by means of rubber washers inserted between steel supporting plate on the upper and lower anchor bolts.

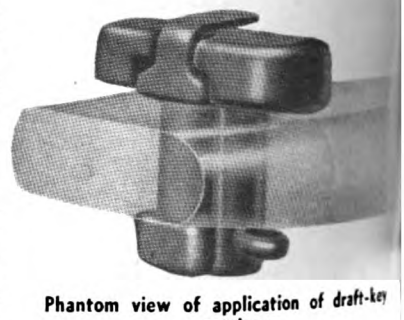
In operation, the piston normally ride at about the center of the cylinder. Air admitted at signal-line pressure of 65 l through the hollow piston rod to the piste center, from which it is delivered throug three lateral holes to the piston walls ar thence past the packing leathers until pre sures are equalized on both sides of th piston. Any upward movement of th piston then compresses air above it ar permits air to flow past the bottom leath into the space below. Similarly when th piston moves downward air pressure built up below the piston and additional a is drawn in above.

This pumping action continues until a pressure is built up to 100 lb. pressure o both sides of the piston permitting it t float freely under light road shocks ar small spring travel. In case excessive shoc carries the piston nearly to the top of th cylinder, air pressure builds up rapidly t resist and finally stop this movement. Th excess air is then slowly exhausted throug relief valve *B* to the underside of the piste Rebound is similarly cushioned when th piston moves towards the bottom of th cylinder, only in this instance the exce air passes through relief valve *A* back int the air supply line. Since there is no los of air to the atmosphere very little air i required for operation of the cylinders. Th cooling effect when air expands through th relief valves is said to offset heating due t compression, so there is no material increas in temperature.

The Glide-Ride air cylinder for railwa passenger cars is a patented device, th principle of which has been thoroughl tested on other types of vehicles. It simple and no mechanical parts requi close tolerances or frequent adjustment.

Draft-Key Retainer

The Illinois Railway Equipment Company Chicago 4, is now distributing an improve draft-key retainer which has the approva of the A.A.R. as an acceptable alternat standard. It replaces the plug retaine which is held in place by a cotter and i intended to insure against the accident removal of a retainer and subsequent dis placement of the draft key. The devic consists of a grooved plug in which a lock ing member, shaped to fit the grooved por tion of the plug, is inserted and locked in place by bending over a projection on th keeper portion of this member.



Phantom view of application of draft-key retainer

atch Bolts

rdened self-tapping patch bolts are :red by the Parker-Kalon Corporation, Varick Street, New York 14, as being st effective for making repairs to pas-ger-car side sheets without the necessity tearing out any interior trim. They are lied through holes punched or drilled he replacement sheet to match the holes

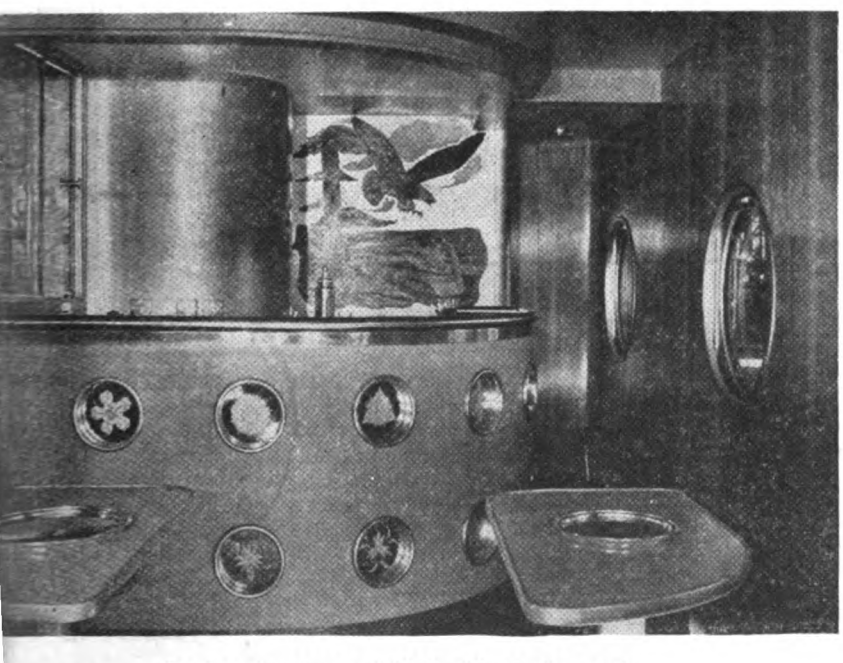
atch bolt used in applying passenger-car side sheets

the structural members of the car. The ts are turned in with a socket or an end nch and, when firmly seated, the square dshank of the bolt is removed with a ksaw, bolt cutter or chisel. The head is n dressed down to a standard round tour with a file.

arlite nterior Paneling

aptable to a wide variety of applications railway car construction, attractive and able Marlite interior paneling, made by rsh Wall Products, Incorporated, Dover, o, is manufactured in a complete range colors and patterns that meet any in-lation requirements and will comple-it any decorative scheme. Attractive d veneers and wood patterns have al-ly gained popularity for use in lounge cars, club cars and dining cars where warm and pleasing interiors are required.

Marlite plain colors and tile patterns with a high-heat bake finish and heat-resistant, are available for finishing off sanitary facilities in cars, as well as in other locations where modern and easy-to-clean interiors are required. A sealed surface which is resistant to moisture, grime, mild acids and human hair oil reduces maintenance upkeep and provides an attractive, colorful interior. Delivered in large, wall-size panels, Marlite is quickly and easily cut and applied.

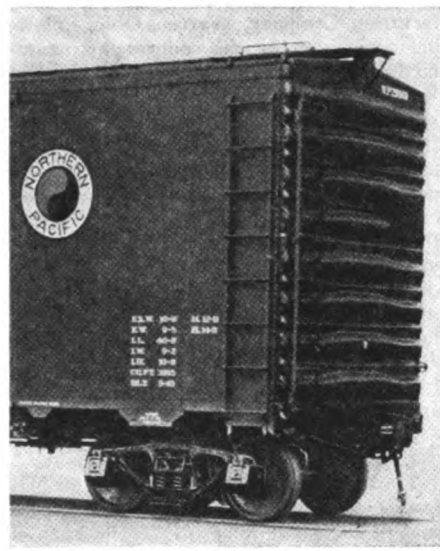


Bar in a lounge car finished with Marlite panels

Box-Car Ends

The Standard Railway Equipment Company, Hammond, Ind., has changed the design of its Dreadnaught steel end for box cars to provide a 1-in. increase in the depth of corrugation. Corrugations are now 4-in. deep and they are reinforced on the compression side since tests made by the company have indicated that failures developing in service occurred on the compression side before they did on the tension side. The use of this improved corrugated beam construction in combination with the semi-restrained beam action of W-section corner posts results in substantially increased strength and the possibility of weight saving, particularly when high-tensile steels are used.

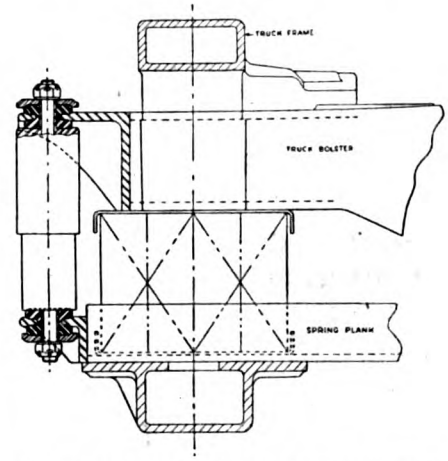
This company has also announced a new design of gondola-car end which provides space in the corners of the end for the use of a W-section corner post construction. The advantages of this type of corner are available without any interference with the inside dimensions of a car.



The depth of corrugation has been increased in this box-car end

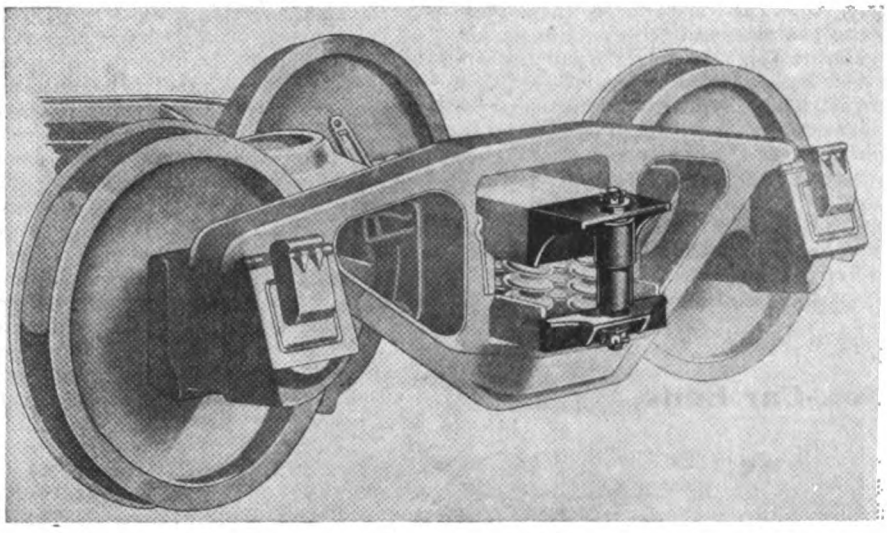
Hydraulic Shock Absorbers

Direct-action two-way hydraulic shock absorbers for freight cars now are well past the experimental stage and are being thoroughly tested on refrigerator and tank cars with excellent results, according to an announcement of the Monroe Auto Equipment Company, Monroe, Mich. The freight-car shock absorbers are similar in design and type of mounting to those used successfully on new streamliners and other passenger equipment. In their development, Monroe has combined improvements made over nearly seven years in shock absorbers for rail passenger cars with experience recently gained in the volume production of direct-action two-way hydraulic shock-absorbing devices for heavy tanks and trucks used in the war.



Hydraulic shock absorbers are mounted outside the spring nest between the bolster and the spring plank

Tests so far have shown that the two-way hydraulics lessen to a minimum the number of times when springs go solid and control rebound as well. The two-way shock absorbers, taking the shock load off the bearings of the freight-car trucks, act to lessen wear on all parts of the car including the springs, brakes, wheels and axles. Comparative tests of tank cars equipped with the two-way hydraulics and cars not so equipped showed that on cross-country runs the steel straps holding the



Hydraulic two-way shock absorber shown as it would be mounted on a freight-car truck

tanks on the cars without the shock absorbers worked loose. Resultant sloshing of oil in the tanks, increasing sidesway and shock, caused so much wear and tear that it was necessary to make major repairs before the cars were again ready for service. Straps on the hydraulically equipped cars remained tight.

Other experiments are said to have disclosed that breakage losses on such products as eggs and other perishables and tile were reduced materially when cars were equipped with two-way hydraulic shock absorbers. This extended even to meat which is hung on hooks in the cars. Cushioning with the two-way shocks cut down the percentage of meat falling off the hooks and thus being damaged.

These shock absorbers are mounted on the outside of the freight-car trucks between the bolster and the spring plank, and do not take the place of the springs. Full spring action is retained.

Front End Arrangement

The Amweld locomotive front end arrangement has been announced as the first product of the newly formed Railway Equipment Division of the American Welding & Manufacturing Company, Warren, Ohio, following acquisition by the company of manufacturing rights to the basic Locomotive Economizer Corporation patents and designs. The device is intended to provide a free and uniform flow of gases to the locomotive stack while offering maximum impedance to the sparks and cinders. Of unit construction and individually engineered, this front end may be installed with a minimum of fitting in any of the principal types of locomotives. With necessary supports, it consists essentially of a streamline housing of 5/16-in. steel which totally encloses the exhaust-steam entry and stack outlet. Louvres of 1¼-in. by 1¾-in. by ¼-in. angles are located at the front and sides of the housing to provide an easy exit for flue gases while serving to arrest sparks.

The application of aerodynamic principles to the design of the housing and arresters is said to contribute much to the efficiency of operation of the unit by permitting the use of a larger exhaust nozzle, reducing the back pressure on the cylinders below the range normally encountered. In addition to increasing draft through improved airflow to the stack, the curvature of the housing tends to equalize the draft through the flues. The central flues, which would normally bear the burden of the draft, are restricted so as to apportion the load more evenly. This equalized draft tends to eli nate concentrated burning and to result an even firebed with an accompanying duction in fuel consumption.

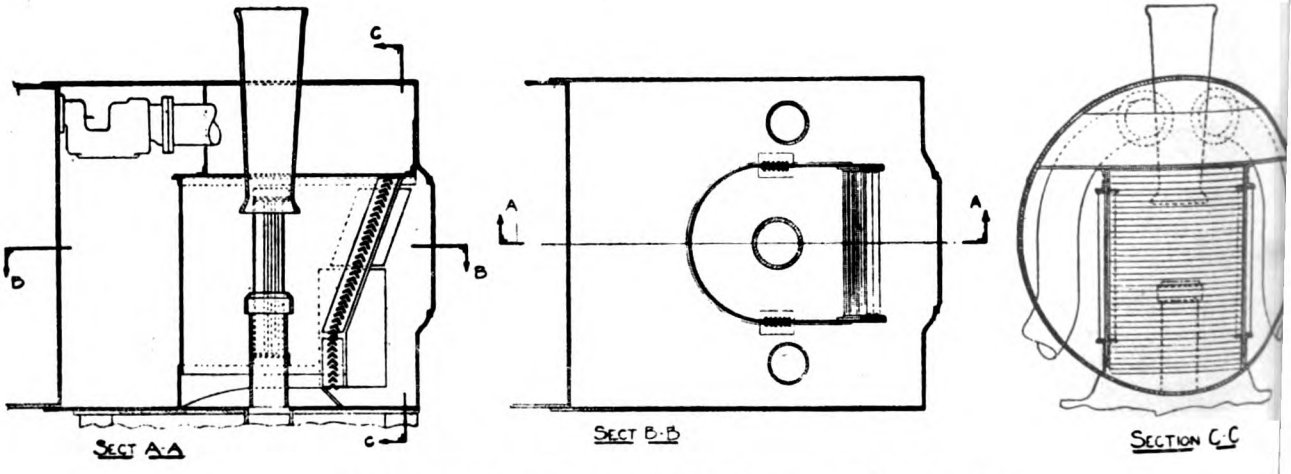
The combination of louvre design location is said to be particularly suite reducing both the size and quantity cinders emitted from the stack. Larger ders never enter the louvres, being exclu by their size and inertia; these drop d to the bottom of the unit where they r be cleaned out periodically. Smaller cin which succeed in entering between the f legs of the louvres break up on impact v the second leg and are pulverized to un jectionable size.

Maintenance problems in connection w this front end are considerably simplif Flue cutting, the result of the abra action of cinders travelling through flues, is related to their velocity of tra By equalizing draft, flue cutting is min ized as a result of lessened cinder velocit Repair work is further lessened by the s stitution of rolled-steel louvres for conv tional nesting, thus eliminating the fami problem of clogged and burned-out nett

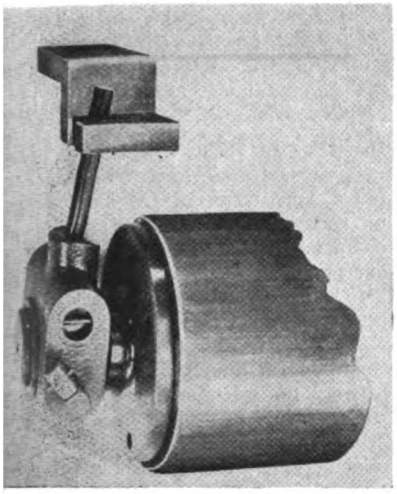
Speed Indicators

Railroad speedometer equipment be manufactured by the Jones Motrola C poration, 432 Fairfield avenue, Stamfo Conn., can be applied to any type of lo motive, steam, Diesel, electric, or gasol These speed indicators with cab-mount gauges are standard equipment on the la motives of a number of roads and are o on some locomotives by others.

An installation consists of speedom head actuated by a fly-ball governor flexible shaft of suitable length, and drive unit. There are two models of d units, one designed for use with ro bearing mounted axles, and the other plain friction type bearings. For ro bearing axles, the drive unit is mounted the cover of the box, as alignment and movement of the axle are controlled. forked angle fastened to the end of axle engages the cross bar and drives unit. For plain-bearing axles the d unit is mounted directly on the end of



Diagrammatic views of Amweld locomotive front end arrangement



ounting for speedometer drive unit on a plain-bearing axle

le and moves up and down and laterally an integral part, eliminating the problem alignment. A suitable bracket on the inside of the box engages the vertical l and keeps the housing from turning.

moke ozzle Silencer

silencer is now furnished by the T-Z ilway Equipment Company, Chicago, in nit assembly with the smoke-preventer zle which it has been furnishing to the roads. One end of the nozzle is ma- ed and fitted into a combustion sleeve, the other end is fitted with a ½-in. nipple 3 in. long. The silencer, fitted und the nozzle, consists of an outside l made of a steel stamping and an inner l made of hardware screen. A ½-in. ket of acoustic material is placed be- en them. This assembly is held firmly lace by a gland nut which fits around nipple.

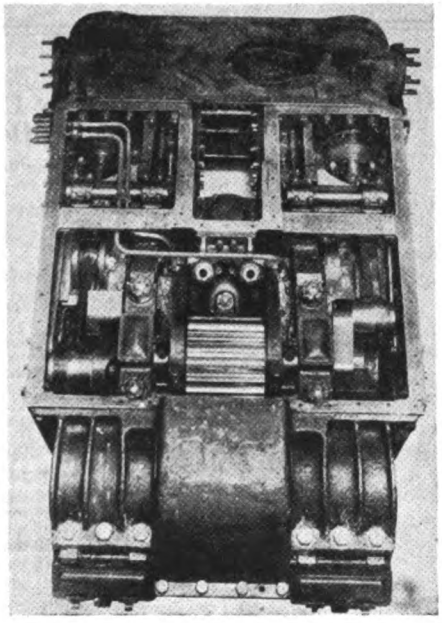
he design permits the silencer to be oved easily and quickly so that it can leaned and the acoustic material or smoke-preventer nozzle removed if necessary. The bracket which holds the unit may be attached to the outside firebox sheet in any position to prevent interference with staybolt heads, piping, and other parts. It is essential that a 1-in. opening be provided between the silencer and the outside firebox sheet so that the correct amount of air will be drawn into the unit.

Franklin Changes Locomotive Booster

The Franklin Railway Supply Company, Incorporated, New York 17, has recently made a number of improvements in its Type E booster. This booster is now designated as the Type E-1 and provides for operation up to 35 m.p.h. and can be placed in operation at speeds up to 22 m.p.h.

The steam passages of the cylinder have been redesigned to produce a better steam flow. The pistons are made from cast steel and equipped with sectional packing. The axle bearing cap is designed to allow the use of through bolts. Stops for valve and cylinder bushings have been provided on valve chest heads and the cylinder heads. The crank shaft has a strengthened crank-arm fit. Principal parts of the valve gear, such as the eccentric crank, eccentric rod and valve rocker, are made from heat-treated alloy steel to increase their strength.

The Type E-1 booster can be furnished with Alemite lubrication for the crank shaft, bearings and the idler-gear bearing, which permits applying grease to these bearings from the outside if this is desired.



Type E-1 booster suitable for service at speeds up to 35 m.p.h.

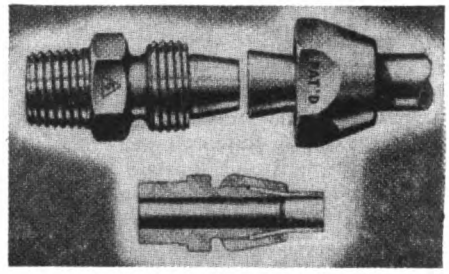
Rust Inhibitors

Two types of rust inhibitors, Carbo C and Carbo N, which have been designed for temporary rust prevention on metallic materials during inside storage, have been developed by the Carbozite Corporation, Pittsburgh, Pa. Carbo C inhibitor, the more universal of the two is inactive on all metals and alloys, including magnesium and aluminum, while Carbo N inhibitor has no effect on iron, steel or ferrous alloys, although it does have a slight action on softer metals, such as lead, zinc, magnesium and aluminum.

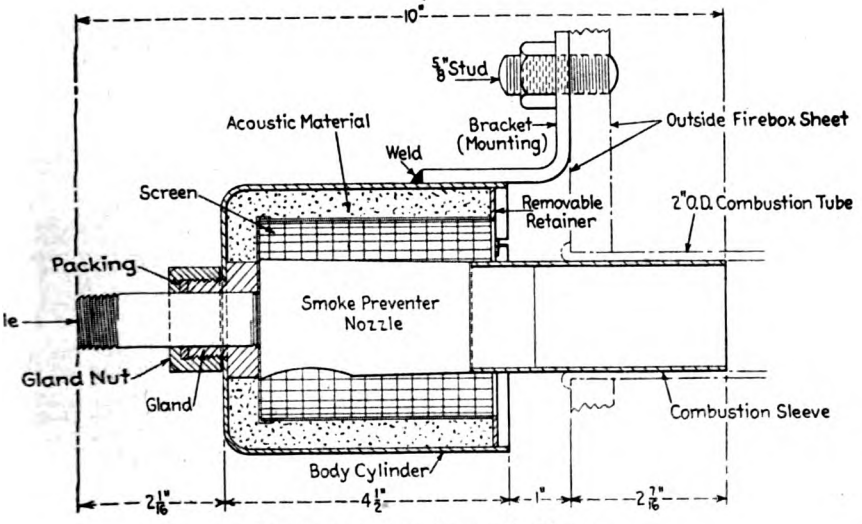
Carbo C and Carbo N prevent rust in lines that drain salt solutions and can be also used in a mixture with cutting oils to protect threads from rust. Both Carbo C and Carbo N are distributed in concentrated form only, and are mixed in proportions of from 25 to 100 gals. of water for each gallon of inhibitor.

Flared Tube Fittings

Leakproof joints even under maximum vibration and pressure are said to result from the use of flared tube fittings manufactured by the Grinnell Company, Providence 1, R. I. These are two-part fittings which are so designed that there is no shearing action to injure the tubing at the point of flare when the nut on the fitting is tightened. No reduction in diameter of the tubing results when the fittings are applied and there are no obstructions at the joint. Stock sizes of these fittings are available in steel up to ½ in. outside diameter and in malleable iron up to ⅝ in. outside diameter. Stainless-steel and brass fittings can be furnished.



Two-piece flared-tube fitting



Arrangement of smoke nozzle silencer

NEWS

A.S.M.E. Railroad Division Program for 1945 Meeting

THE Hotel Pennsylvania,, New York, will be the headquarters for the 1945 annual meeting of the American Society of Mechanical Engineers which is scheduled for the week beginning Sunday, November 25. Among the divisions to hold sessions are Fuels, Applied Mechanics, Railroad, Oil and Gas Power, and Heat Transfer. Fuels will be discussed along the lines of railroad requirements as originally planned for the Chicago semi-annual meeting which was cancelled because of O. D. T. regulations. One session of the Oil and Gas Power Division will be devoted to oil and gas power, two to gas turbines, and the fourth to a symposium on gas turbines. Thursday, November 29, will be Railroad Day and the annual luncheon of the division will be held at noon. At 8:15 p.m. the Railroad Division will hold a joint session with the Applied Mechanics Division. The technical sessions for the day are as follows:

RAILROAD DIVISION

Thursday, November 29

9 a.m.

Railroad Motive Power Trends, by Ralph P. Johnson, chief engineer, The Baldwin Locomotive Works.

2 p.m.

Railroad Passenger Cars—1946 Models, by A. W. Clarke, assistant general mechanical engineer, American Car and Foundry Company.

Tests of Oil-Film Journal Bearings for Railroad Cars, by S. J. Needs, Kingsbury Machine Works, Inc.

JOINT SESSION RAILROAD AND APPLIED MECHANICS DIVISIONS

8:15 p.m.

Crank-Pin Design for Locomotives, by O. J. Horger, chief engineer, Railway Division, The Timken Roller Bearing Company, and W. I. Cantley, mechanical engineer, Association of American Railroads.

Design and Application of Rail Transportation Gearing, by D. R. Meier and J. C. Roads, General Electric Company.

The Railroad Division will also hold a joint meeting with the Fuels Division on Wednesday, November 28, at 2 p.m. when there will be a Symposium on the Utilization of Solid Fuels in Railroad Motive Power. The speakers will be K. A. Browne, research consultant, Chesapeake & Ohio; C. F. Hardy, chief engineer, Appalachian Coals, Inc.; A. A. Raymond, superintendent fuel and locomotive performance, New York Central System, and R. A. Sherman, supervisor fuels division, Battelle Memorial Institute.

USS Cor-Ten Cars After Ten Years' Service

IN celebration of the tenth anniversary of the first substantial application of USS Cor-Ten steel, the Carnegie-Illinois Steel Corporation exhibited on October 10 at the Homestead steel works, Pittsburgh, Pa., a group of 14 light-weight freight cars of several types which have been in service during a major part of the period since the development began. Twelve of the cars were originally built of Cor-Ten steel and two were test cars in which the service of Cor-Ten steel was compared with that of Man-Ten steel and hard aluminum alloy. During the afternoon these cars were inspected by members of the Car Construction Committee of the Association of American Railroads, Mechanical Division, and of the American Railway Car Institute Committee on Freight-Car Design then meeting at Pittsburgh. The party were guests of the steel company for luncheon and dinner.

The largest group of cars comprised seven Bessemer & Lake Erie 50-ton light-weight hoppers. These were from the lot of 100 USS Cor-Ten cars weighing a few hundred pounds over 30,000 each which were built in 1935 and have since been in continuous heavy service on the home road. In the design of these cars very thin sheets were employed. The side sheets and top floor sheets were 3/32 in. thick; the bottom floor sheets 1/8 in. thick, and the hopper sheets 5/32 in. thick. The interiors of the cars present the characteristic, uniform pitted appearance of Cor-Ten steel wi no accumulations of heavy spalling sca characteristic of carbon steels. With o exception, there was no visual eviden that any of the sheets in these cars h been weakened by corrosion, although the were signs of more than average corrosi conditions at the horizontal riveted joi between the side sheets and hopper shee In one hopper car there were short breal in a side sheet near the lower end of t joint between the side sheet and the hopp slope sheet. The thickness of the sheet the fracture and other evidences of m chanical damage of the floor sheets su gest that the breaks in this sheet we due to causes other than corrosion.

The general condition of the sides a

Orders and Inquiries for New Equipment Placed Since the Closin of the October Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Central of New Jersey	3[1]	2,000-hp. Diesel-elec. pass.	Baldwin Loco. Wks.
Missouri-Kansas-Texas	2[2]	2,000-hp. Diesel-elec.	Electro-Motive
St. Louis-San Francisco	2[2]	2,000-hp. Diesel-elec.	Electro-Motive
Union Pacific	1[3]	3-unit 6,000-hp. Diesel elec.	Fairbanks-Morse & Co.
	1[3]	4-unit 6,000-hp. Diesel-elec.	Electro-Motive

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Clinchfield	20	70-ton covered hopper	American Car & Fdry.
Missouri-Kansas-Texas	150	40-ton automobile[4]	Company shops
	50	50-ton automobile[4]	Company shops
Reading	1,000	50-ton box	Company shops
St. Louis-San Francisco	300	50-ton automobile	Pullman-Standard
	200[5]	70-ton hopper ballast	American Car & Fdry.
	100	70-ton covered hopper	Company shops
	20	Cabooses	Company shops

FREIGHT-CAR INQUIRIES

Elgin, Joliet & Eastern	300	50-ton gondola
	200	50-ton flat
	50	50-ton hopper
New York, Chicago & St. Louis	500	50-ton box
	100	70-ton covered hopper

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Denver & Rio Grande Western, Chicago, Burlington & Quincy, Western Pacific, Missouri-Kansas-Texas, St. Louis-San Francisco	6[6]	10-car trains	Edw. G. Budd
	24[7]	2 bagg.-mail	Pullman-Standard
		4 chair	Pullman-Standard
		2 chair-lounge	Pullman-Standard
		2 diners	Pullman-Standard
		12 sleeping	Pullman-Standard
		2 obs.-lounge	Pullman-Standard
Pennsylvania	70[8]	Coaches	Company shops
	5[8]	Double-unit dining	Company shops
	5[8]	Lounge-buffet-obs.	Company shops
	5[8]	Lounge-buffet-bagg.	Company shops

[1] For use in commutation service. The locomotives will be of double-end type; that is, having operator's cab at front and rear.

[2] For use on the Texas Special between St. Louis, Mo., and San Antonio, Tex.

[3] The three-unit locomotive has been designed for a maximum operation of 65 m.p.h. It will tested on a run from south of Salt Lake City, Utah, to Los Angeles, Cal., in freight hauling possibly in passenger service. The four-unit locomotive is to be tested between Green River, W and Ogden, Utah, under exact loads and conditions to determine comparison of performance of unit with the Union Pacific's "Big Boys," or 4000 class, 4-8-8-4 type, locomotives. Later tests of new locomotive will also be conducted between Salt Lake City and Los Angeles.

[4] With loading devices.

[5] Pending approval by the United States District Court. The automobile cars will cost $1,639,0 the hopper ballast cars, $895,000.

NOTE: The St. Louis-San Francisco has petitioned the United States District Court for permis to purchase three 4,000-hp. Diesel-electric road engines as part of proposed spending of $7,331, on post war equipment for the road's passenger and freight service.

[6] The six trains of stainless steel construction, will be hauled by Diesel power. They will be p in operation next year between San Francisco, Calif., and Chicago, and will be operated by three railro jointly under the name of "California Zephyr." The trains will embody all of the most recent velopments in design and construction, including cars with the "vista dome" features. The total vestment for the cars and locomotives will be approximately $10,500,000, divided among the th railroads.

[7] For two 12-car streamline trains to replace present equipment now operating on the Texas Spe between St. Louis, Mo., and San Antonio, Tex.

[8] These cars are to be used to reequip the Trail Blazer and the Jeffersonians, over-night coach tra between New York and Chicago and St. Louis, Mo.

chord members of these cars indicates they have stood up well under service iiring frequent passage through car pers.

nother hopper car of the same design one of five built in 1935 for the Pitts-gh & Lake Erie. The side sheets of this had already failed through corrosion he junction of the side sheets with the per sheets and narrow patches had been lied.

wo test cars for direct comparison of service of Cor-Ten steel with other ma-als were also in the exhibit. In one of ie cars the comparison is with a hard ninum alloy and in the other with USS n-Ten steel. These are from a group thirteen 50-ton hopper cars owned by Carnegie-Illinois Steel Corporation ich were rebuilt as test cars for com-ing USS Man-Ten, copper-bearing steel l aluminum alloy with the USS Cor-n. The comparisons were between 3/16- and 1/4-in. Cor-Ten, 3/16-in. and 1/4-in. in-Ten, 1/4-in. copper-bearing steel, and in. aluminum. The test has now been npleted after an average service to pene-tion as follows: 3/16-in. Cor-Ten, 51 mos.; in Cor-Ten, 66 mos.; 3/16-in. Man-Ten, mos.; 1/4-in. Man-Ten, 36 mos.; 1/4-in. pper steel, 35 mos.; 1/4-in. aluminum, 52S hard, 30 mos.

The Bessemer & Lake Erie now has in service over 6,000 lightweight hopper cars of USS Cor-Ten construction with nominal capacities of 70 and 90 tons. These cars were first built in 1936. The bodies of both capacities are the same. The weight of the 90-ton car is 48,500 lb. The side and top floor sheets are 1/8-in. material; the bottom floor sheets of 5/32-in. material, and the hopper sheets 3/16-in. The two cars exhibited are in good condition.

The remaining two cars of the exhibit were 50-ton box cars, one built in 1938 for the Bessemer & Lake Erie by the Pullman-Standard Car Manufacturing Company of light-gauge welded sheets, weighing 38,300 lb.; the other, weighing 43,200 lb., was built by the American Car and Foundry Company in 1941. The body structures of both of these cars are in generally good condition.

AM and FM Radio Systems Tested

FREQUENCY modulation and amplitude modulation radio systems were tested simultaneously under identical operating conditions utilizing equipment of comparable engineering specifications in experiments concluded October 1 by the Atchison, Topeka & Santa Fe and the Farnsworth Television & Radio Corporation

The tests, conducted in the Santa Fe Corwith yards in Chicago, indicated that both FM and AM systems are capable of rendering satisfactory service in railroad operation, according to engineers in charge of the experiments. Both systems, it was pointed out, have certain inherent advantages, and a choice would depend on the economic, installation, operation and maintenance factors involved in individual projects.

The equipment tested for both AM and FM employed the "auto pulse" checking system, in which a small light flashes in the locomotive cab every few seconds when the engine is in operating range of another radio-equipped unit. Because of its safety factor, it was pointed out, this new check system will have many applications in the railway field. The pulse technique employed in this system is an adaptation of a war-time identification development whereby friendly aircraft can automatically identify each other.

The tests were made in the presence of W. N. Krebs, chief engineer of the Safety and Special Services Division of the Federal Communications Commission; Major H. A. Mugliston of the British Army staff, Washington, D. C., and John L. Niesse, New York Central, chairman, and other members of the Train Communications Committee of the Association of American Railroads.

Supply Trade Notes

PITTSBURGH STEEL FOUNDRY CORPORATION, FORT PITT DIVISION.—The Pittsburgh Steel Foundry Corporation, Glassport, Pa., has purchased the plant and equipment of the Fort Pitt Steel Casting Company, McKeesport, Pa., which it will operate as the Fort Pitt Division. *T. F. Dorsey*, who

T. F. Dorsey

has had many years of varied experience at Fort Pitt, has been appointed general manager of the division. Since the first of this year, Mr. Dorsey has been associated with Pittsburgh Steel Foundry in an assistant sales manager capacity. During the previous ten years he had been Fort Pitt's sales manager.

Ralph W. Payne has been appointed southern representative on railway specialties, general castings and machine work, with offices in Washington, D. C., for the Pittsburgh Steel Foundry Corporation, Glassport, Pa.

◆

AMERICAN LOCOMOTIVE COMPANY.—Eleven of the 12 buildings erected by the government on land leased from the American Locomotive Company at the Schenectady, N. Y., plant in 1942 have been purchased by the company and now are devoted to peacetime production. These buildings include four major and seven auxiliary structures. All were used for the production of war materials, including tanks and tank destroyers. The largest of the buildings purchased is the gun tube shop covering an area of 109,000 sq. ft. Others include combat tank assembly and mobile howitzer assembly shops and the

Robert B. McColl

government warehouse, now a Diesel parts warehouse. Some of the buildings now will be devoted to the development of a new line of Diesel locomotives soon to make its appearance.

Robert B. McColl, vice-president in charge of manufacturing, has been elected executive vice-president of the American Locomotive Company. *W. L. Lentz*, of Schenec-

Miscellaneous Publications

"A SURVEY IN SEATING."—Heywood-Wakefield Company, Gardner, Mass.—The much-discussed study of body measurements conducted by Dr. Ernest A. Hooton, professor of anthropology at Harvard University, has been published in book form by the Heywood-Wakefield Company, sponsors of the survey. The book reports the findings of the investigations and includes more than 50 tables of correlations prepared by the research staff. In addition to the report of Dr. Hooton's work, the book includes information on the results of an independent survey made by the company on body shapes. The book is available to members of the railway industry without charge.

tady, N. Y., who directed the company's tank and locomotive manufacturing program there during the past five years, succeeds Mr. McColl as vice-president and *J. J. Smith* succeeds Mr. Lentz as manager of the Schenectady plant. *Joseph W. S. Davis* has been appointed assistant district sales manager, New York district, with headquarters in New York. Mr. Davis was previously assistant sales manager of the Railway Steel-Spring division. *John Seagren* has been appointed chief engineer in the Diesel engine division at Schenectady.

Robert B. McColl, executive vice-president, was educated at Kilmarnock Academy and the Science and Art College, in his native Kilmarnock, Scotland. He began his apprenticeship in locomotive building with the Glasgow & Southwestern railway in Scotland. After a period with Robert Stephenson & Sons in Darlington, England, he joined the Montreal Locomotive Works in Canada, an affiliate of American Locomotive Company. After World War I he was with the Armstrong-Whitworth Company in England but soon returned to America as assistant manager of the Schenectady works of American Locomotive. He since has been successively mana-

W. L. Lentz

ger of this plant, president of the company's Diesel engine manufacturing division, the old McIntosh & Seymour Corp., president of the Alco Products division, and vice-president in charge of manufacturing for the company. During the war, he directed the company's huge war production program.

W. L. Lentz, vice-president in charge of manufacturing, took over the management of the Schenectady plant at the outset of the war and supervised the conversion of the plant from its locomotive building operations to tank production. He was an aviation cadet and artillery officer in the last war and began railroading in 1913 with the New York Central. For an interval after 1937, Mr. Lentz was sales manager of the Standard Stoker Company.

John Seagren, chief engineer, Diesel engine division at Schenectady, was in the employ of Fairbanks, Morse & Co. from 1925 to 1932, specializing on Diesel engines and air compressors as a design engineer until he was appointed development engineer in the research and development department. He joined the Atlas Imperial

John Seagren

Diesel Engine Company as development engineer in charge of experimental and development work in 1932 and in 1936 was appointed chief engineer in charge of all experimental work and engineering in both the Oakland, Calif., and Matoon, Ill., plants He became development engineer on post-war production for the Northern Pump Company, Minneapolis, Minn., in May, 1944, and in July 1945, became associated with the American Locomotive Company.

◆

MONROE AUTO EQUIPMENT COMPANY.—The Monroe Auto Equipment Company, Monroe, Mich., has announced an expansion of its factories to a point where 454,000 sq. ft. of floor space will be available, more than three times the space available in 1940. Major steps in this expansion include a new plant purchased in Hillsdale, Mich., for the production of truck seats and for molding and compounding rubber, and enlargement of two plants in Monroe.

Donald L. Whitehouse, whose appointment as manager of the Chicago office of the Monroe Auto Equipment Company, Monroe, Mich., was reported in the October issue, was born in Chicago on January 14, 1906. Upon his graduation from Wash-

Donald L. Whitehouse

ington University, St. Louis, Mo., in 1933, he went with the Firestone Tire & Rubber Co. in the production control department at Los Angeles, Calif. In 1939 he became sales manager of the Hydro-Gas Company, Winston-Salem, N. C., and in 1940 was appointed assistant manager of the Wash-ington, D. C., office of the Monroe Auto Equipment Company.

◆

FIRTH-STERLING STEEL COMPANY.—*Floyd Rose,* formerly president of Vanadium Alloys Steel Company, has been elected chairman of the board of Firth-Sterling Steel Company, McKeesport, Pa. Mr. Rose had been with Vanadium-Alloys Steel Company since 1926, and prior to that has been vice-president of the Heppenstall Company. According to Mr. Rose, The Firth-Sterling Steel Company plans to add more melting and rolling units to its mill facilities and will expand its research and metallurgical departments.

◆

PANTASOTE COMPANY.—*Frank Geraci* formerly with the New York Central System, has been appointed manager of the railroad division of the Pantasote Company. Previous to his connection with the New York Central, Mr. Geraci was chief expe-

Frank Geraci

diter of the Washington, D. C., and Cincinnati, Ohio, offices of the War Department's Transportation Corp., and was with the War Production Board in the transportation equipment division.

◆

ELECTRONIC LABORATORIES.—*John W. Cyler* and *F. Theodore Hegeman* have been appointed to the sales department of Electronic Laboratories. Mr. Cyler was head of the order department. Mr. Hegeman will represent Electronic in each of its sales fields.

◆

AMERICAN WELDING & MANUFACTURING COMPANY.—*Raymond H. Gaver* has been appointed chief engineer and *Jonas D. Bigelow* development engineer of the newly established railway equipment division of the American Welding & Manufacturing Company, Warren, Ohio.

Mr. Gaver, who will head the division, has been with the company since 1944, working at research and development on new car and locomotive components. He was born at Columbus, Ohio, and attended Columbus grade schools and Columbus Academy. He later went to Kemper Military Institute and in 1935 received the degree of B.S.M.E. from Purdue University. Upon graduation he joined the

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AMCCW congratulates the American Railroads on "doing the impossible" in wartime. We know that it's still being done . . . that the "Cease Firing" order has not meant "Cease Redeploying"

We know what your problems have been because we have been confronted with the same over-all conditions. And figures show that we too have been producing. Our records show an increase in the number of chilled car wheels made and shipped *and an increase of over 200% in gross ton miles per wheel above the pre-war period on all Class 1 railroads.*

AMCCW research activities have been carried on. New metals and designs have been studied and tested, new developments brought nearer to the foundry-production stage. And, as railroad improvements emerge from research laboratory into actual service, you can be sure that better-than-ever chilled car wheels will be among them.

ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

230 PARK AVENUE, NEW YORK 17, N. Y. · 445 NORTH SACRAMENTO BOULEVARD, CHICAGO 12, ILL.

Organized to achieve: Uniform specifications — Uniform inspection — Uniform product

4249

Buckeye Steel Castings Company at Columbus as a service engineer where he worked on railroad equipment, specializing in trucks, couplers and miscellaneous car

Raymond H. Gaver

castings. From 1942 to 1943 he was chief engineer of the Ohio Tubular Products Company.

Mr. Bigelow was born in Jefferson, Ind. He attended private and public schools in that city and also went to Tamalpais Vocational School at Mill Valley, Calif. He began his business career in 1913 as a draftsman in the employ of the American Car and Foundry Company. He later served as a draftsman on the Louisville & Nashville. During 1917-19 he was overseas as an army engineer in World War I. He rejoined the American Car and Foundry Company upon his return to civilian life and in 1922 went into the mechanical engineer's office of the Cleveland, Cincinnati,

J. D. Bigelow

Chicago & St. Louis. In 1931 he became assistant chief draftsman in the employ of the New York Central and from 1942 until he joined American Welding he was special engineer in the office of the general superintendent of motive power and rolling stock.

◆

GENERAL ELECTRIC COMPANY.—*Henry L. Guy,* assistant manager of the transportation divisions at the General Electric Company's Erie, Pa., works, retired August 1, after more than 40 years of service with the company. *F. H. Craton* succeeds Mr. Guy. Mr. Guy is a graduate of Virginia Polytechnic Institute with a degree in electrical engineering (1904). He joined General Electric in Schenectady, N. Y., in 1905, and in 1906 was transferred to what was then the foreign department as an engineering assistant. He entered the commercial branch of the old railway department at Schenectady in 1908, moving to Erie when the transportation department activities were consolidated there. He was appointed assistant manager of the transportation divisions in 1939.

◆

PHILCO CORPORATION.—*Charles F. Greene* has been appointed Atlanta, Ga., representative of the Storage Battery division of the Philco Corporation. Mr. Greene formerly was connected with A. K. Sutton, Inc., Philco distributors in Charlotte, N. C.

◆

FAIRBANKS, MORSE & CO.—*John S. King,* formerly manager of the pump division, has been appointed acting manager of the railroad division of Fairbanks, Morse & Co., to succeed C. H. Wilson, deceased. *Arnold G. Brown,* assistant manager of the

John S. King

pump division, has been appointed to succeed Mr. King as manager of that division.

Mr. King began his career as a student in the Beloit, Wis., plant. He was transferred to the Indianapolis, Ind., plant in 1921 and a year later appointed territorial representative of the Pump department in Chicago. He was appointed Pump department manager of the Chicago branch in 1930. He was appointed manager of the New Orleans, La., branch in 1937 and manager of the Pump division earlier this year.

◆

HARLAN & HOLLINGSWORTH CORPORATION.—*Lewis A. Belding* has been appointed president of the Harlan & Hollingsworth Corporation, Wilmington, Del., to expand the company's post-war activities to include the production of freight cars. Mr. Belding recently completed an engineering assignment with the Henry J. Kaiser Company, which followed 15 years of engineering, designing, and selling of railroad cars for the General American Transportation Corporation of Chicago and an earlier association with the American Car and Foundry Co.

CHICAGO PNEUMATIC TOOL COMPA
Guy J. Coffey has been appointed v
president in charge of sales of the Chic
Pneumatic Tool Company, New York.
Coffey was born in Champlain, Ill.
began his career in the employ of the C
Steel Foundry Company at Lima, O

Guy J. Coffey

where he later became chief elecrician
1919 he became plant engineer for
Detroit Steel Casting Company and
1930 resigned to become special sales en
neer for the Black & Decker Mfg. Co.
joined the Chicago Pneumatic Tool Co
pany in 1933 as a salesman in the Philad
phia branch. He was later transferred
the Cleveland office and subsequently
came manager of the West Coast office.

◆

EDWARD G. BUDD MANUFACTURING C
PANY.—*Joseph F. Clary* has been appoi
assistant railroad sales manager of
Edward G. Budd Manufacturing Compa

J. F. Clary

Philadelphia, Pa. Mr. Clary is a gradu
of the Massachusetts Institute of Tec
nology (1929) with a B. S. in engineeri
Upon graduation he worked as an engine
for the Firestone Tire & Rubber Compan
Akron, Ohio. He joined the Budd Compan
in 1933 as an engineer in the Navy Depar
ment. In 1934 he was appointed railro
division engineer, later project engineer a
project manager, and in 1940 became mana

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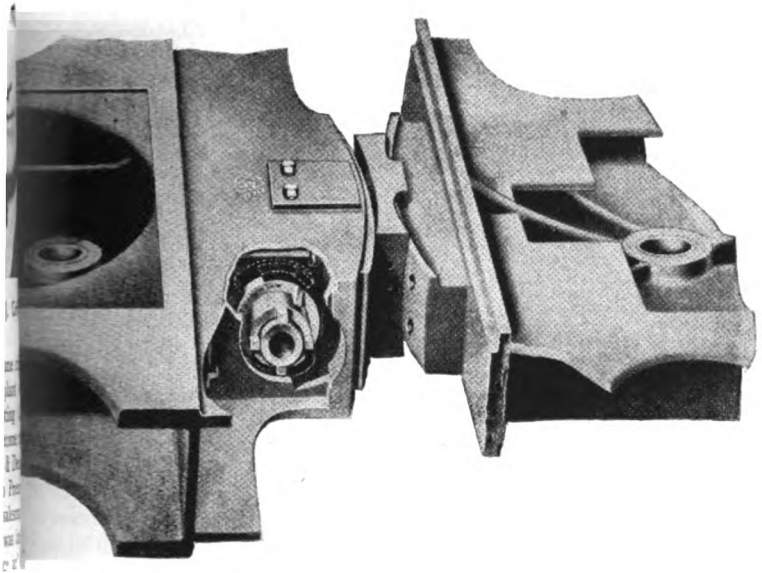
REDUCE MAINTENANCE

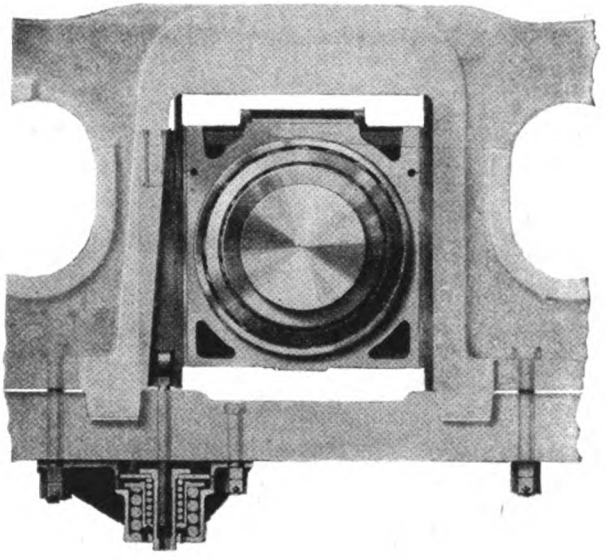


THE FRANKLIN E-2 RADIAL BUFFER

by means of its spherical and cylindrical faces, permits movement in any direction, while maintaining a predetermined frictional resistance to dampen oscillation between engine and tender. By eliminating lost motion, it reduces strains on drawbars and pins, and definitely lessens maintenance on these parts.

THE FRANKLIN COMPENSATOR AND SNUBBER

compensates automatically for expansion and contraction of the driving box, as well as for normal wear. It also dampens the stresses induced by reversal of forces. By preventing pound, it minimizes the wear on all locomotive bearings, with a substantial decrease in maintenance expense.



FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO

In Canada: FRANKLIN RAILWAY SUPPLY COMPANY, LIMITED, MONTREAL

ger of the railway sales contact division. During the war he worked in the Chemical and Food Process Division of Budd's War Service Department. He later returned to head up the Railroad Sales Contact Division and is now assistant railroad sales manager.

◆

FARNSWORTH TELEVISION & RADIO CORP.—The Farnsworth Television & Radio Corp. has acquired all of the assets of the Halstead Traffic Communications Corporation. Most of the key personnel of the Halstead organization have been added to the Farnsworth staff. *William S. Halstead,* president of the Halstead company, will serve Farnsworth as consulting engineer on radio communications equipment and traffic control as well as on other phases of electronics. *John A. Curtis,* vice-president of Halstead and chairman of its management committee, has been appointed manager of the Farnsworth Communications division. Farnsworth plans to transfer to its Fort Wayne, Ind., plant the Halstead engineering staff as well as that company's laboratory and manufacturing facilities, which heretofore have been in New York.

◆

AIREON MANUFACTURING CORPORATION.—*Jack Kaufman,* head of the new San Francisco, Calif., office of the Aireon Manufacturing Corporation, has been appointed a vice-president. Mr. Kaufman, before becoming associated with the Aireon Corporation, had been engaged for a number of years in electronics in San Francisco. He formerly was president of Heintz & Kaufman, Ltd., and was executive vice-president of Glove Wireless, Ltd.

The Aireon Manufacturing Corporation has purchased all the stock of the Oxford-Tartak Company and the Cineaudagraph Corporation of Chicago. Both companies manufacture radio speakers, microphones and other electronic products.

◆

ARO EQUIPMENT CORPORATION.—The Aro Equipment Corporation, Bryan, Ohio, has announced the appointment of eighteen new jobbers to handle the line of Aro industrial pneumatic tools. These include Rudolf Bass of New York, under the supervision of A. B. Schuhl, local division manager in the territory; the Quality Mills Supply Company, Columbus, Ind., under George W. Gille & Sons, local division managers; the Range Auto Parts, Johnson City, Tenn., under the McEwen Cherry Company, local division managers; the Motor Parts & Equipment Co., LaCrosse, Wis., under J. M. Mase, local division manager; the Morley-Murphy Company, Green Bay, Wis., under C. D. Haven, Jr., local division manager; Equipment Sales and Service and the Washington Machinery & Supply Co., both of Spokane, Wash., under Jack J. Kolberg, company representative; the Casey Tractor & Equipment Co., Portland, Ore., under J. R. Towan, company representative; the T. L. Kuhns Company, Salem, Ore., also under J. R. Towan; the Auto Dealers Supply Company, Los Angeles, Calif., the Craft Shop, San Diego, Calif., under the Burklyn Company local division managers in the territory; the Kendall Hardware-Mill Supply Company, Kalamazoo, Mich., under the supervision of Charles Kocsis, local division manager in the territory; the Reed Process Welding Company, Belleville, Ill., under G. W. Gille & Sons; the Lee Hardware Company, Salina, Kan., under W. L. Etherton; the McFall Auto Works, Globe, Ariz., and Auto Accessories, Inc., Seattle, Wash., under the Burklyn Company; and the San Jose Hardware Company, San Jose, Calif., and Hickenbotham Bros., Ltd., Stockton, Calif., under the H. E. Linney Company.

◆

LANDIS TOOL COMPANY.—*R. F. Ingram,* general sales manager, has been appointed

R. F. Ingram

secretary and vice-president of the Landis Tool Company, Waynesboro, Pa. *W. P. Lotz,* eastern sales manager, succeeds Mr. Ingram as general sales manager.

W. P. Lotz

◇

STANDARD CAR TRUCK COMPANY.—*E. W. Webb,* consulting engineer of the Standard Car Truck Company, Chicago, has retired after 43 years of service.

◆

FEDERAL TELEPHONE & RADIO CORP.—*Norman Wunderlich* has been appointed executive sales director of radio equipment and allied products of the Federal Telephone & Radio Corp., Newark, N. J., manufacturing associate of the International Telephone & Telegraph Corp. Mr. Wunderlich formerly was manager of the communications and electronic division of the Galvin Manufacturing Corporation.

◆

GRAYBAR ELECTRIC COMPANY.—*Harold P. Litchfield,* commercial sales manager has been appointed assistant general sales manager of the Graybar Electric Company. He will supervise all sales contacts with the General Electric Company, including its lamp division, and have charge of Graybar sales in lighting, lamps, power apparatus, marine and signaling.

◆

GENERAL MOTORS CORPORATION.—*Colonel Frederick C. Horner,* formerly assistant to the chairman of the General Motors Corporation on transportation matters, who is now on inactive status in the U. S. Army, is returning to the corporation as director of the field operations sections of the distribution staff, with headquarters in Detroit, Mich.

◆

CARNEGIE-ILLINOIS STEEL CORPORATION.—*Thomas J. Hilliard,* general manager of sales, has been elected vice-president in charge of sales of the Carnegie-Illinois Steel Corporation, U. S. Steel subsidiary. *J. Douglas Darby,* manager of sales in Philadelphia, Pa., succeeded Mr. Hilliard as general manager of sales. *Wesley C. Bobbitt,* assistant manager of sales, has been appointed manager of sales in Philadelphia, and *A. Paul Selby,* assistant to the general manager of sales, has been appointed assistant general manager of sales.

◆

BOWSER, INC.—*Daniel P. Morgan* has been appointed to the railroad sales engineering staff of Bowser, Inc., Fort Wayne, Ind., with headquarters in Washington, D. C. Mr. Morgan, who will cover the southeast railroad division, formerly was assistant district sales manager in the Philadelphia, Pa., office of the Pittsburgh Steel Foundry Corporation. Prior thereto he was a special railway representative of the Hanna Stoker Company.

◆

AMERICAN ARCH COMPANY.—*Arthur F. Becker,* for the past twelve years assistant to the vice-president of the American Arch Company at Chicago, has been transferred as vice-president to the company's New York office. *Charles Ringel,* formerly with the American Locomotive Company, has joined the engineering department of the American Arch Company.

◆

PEERLESS MACHINE COMPANY.—*James E. Thoms,* sales manager of the Peerless Machine Company, Racine, Wis., has been appointed vice-president in charge of sales and general administration.

◆

AMERICAN STEEL & WIRE COMPANY.—*H. A. Squibbs,* assistant general manager of sales of the American Steel & Wire Co. (a subsidiary of the United States Steel Corporation) at Chicago, has been appointed assistant to the vice-president in charge of sales, with headquarters at Chicago. C. T. Gilchrist, manager of the manufacturers products sales division, has been advanced

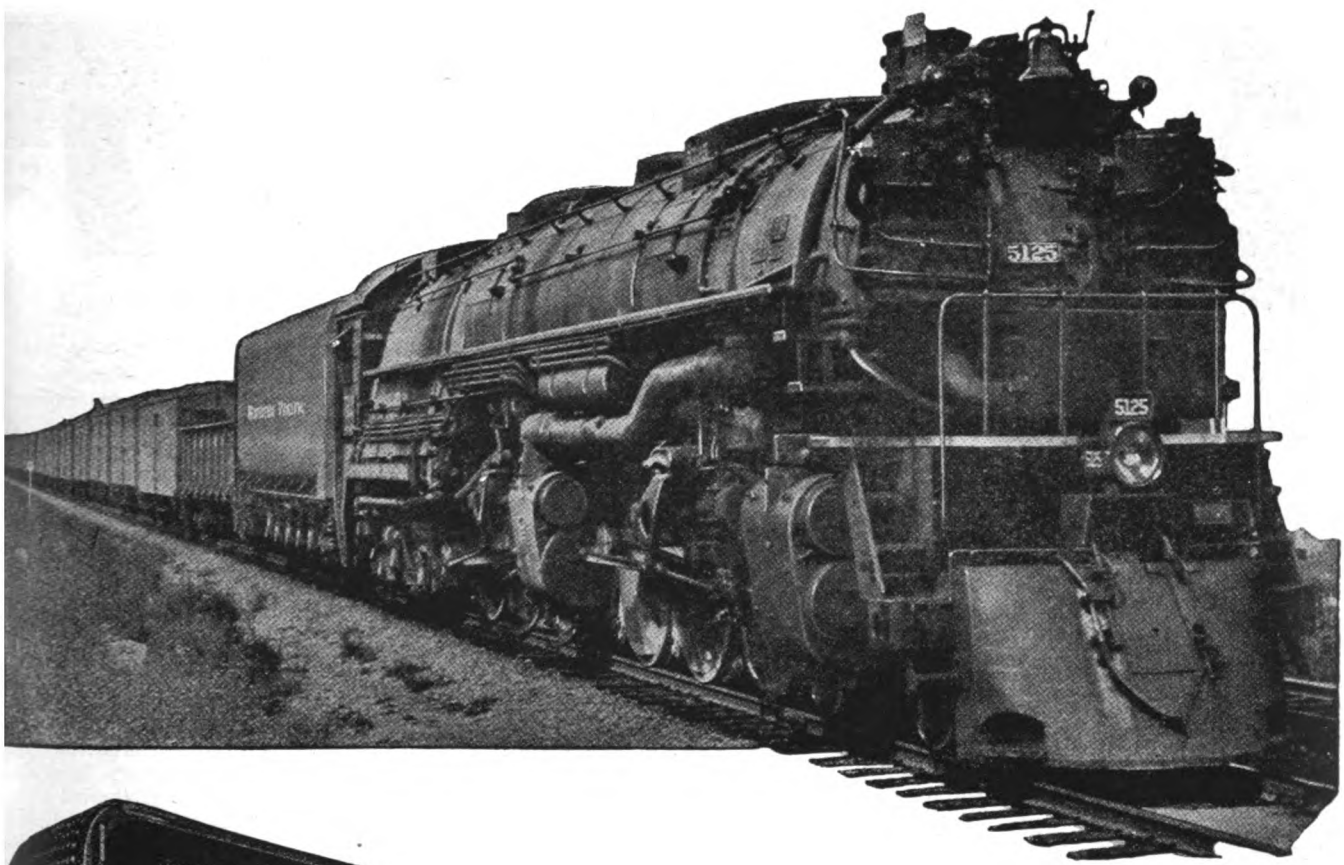
(*Continued on next left-hand page*)

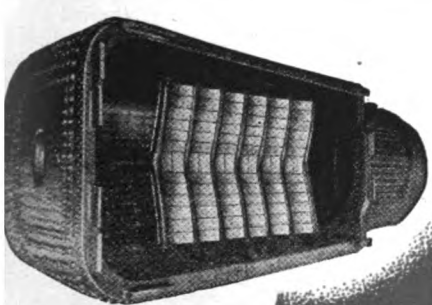
Eating up the miles... economically

● On the heavy haul and the long run, Security Circulators definitely improve locomotive performance.

In addition to improving the circulation of water over the crown sheet and in the side water-legs, Security Circulators reduce honeycombing, flue plugging and cinder cutting.

Security Circulators permit the use of a 100% arch, prolong the life of arch brick, and also act as struts or stays, bracing the firebox against undue distortion.





AMERICAN ARCH COMPANY, INC.

NEW YORK · CHICAGO

SECURITY CIRCULATOR DIVISION

to assistant general manager of sales, succeeding Mr. Squibbs, with headquarters as before at Chicago. *John Graham* has been appointed general manager of sales; *R. F. Curtis,* formerly assistant manager of the manufacturers products division, has been appointed manager of that division to succeed Mr. Graham and *Norman Reed,* formerly in Cleveland, Ohio, district sales, has been appointed assistant manager under Mr. Curtis. *C. N. Schmidt* has been appointed advertising manager to succeed *Wilmer H. Cordes,* who now will devote his full attention to his responsibilities as manager of sales research, development and promotion.

◆

AMERICAN CAR AND FOUNDRY COMPANY.—*G. A. England* has been appointed manager of foundry sales of the American Car and Foundry Company with headquarters in New York. Mr. England attended Mis-

G. A. England

souri University where he specialized in chemical engineering. He joined American Car and Foundry in January, 1923, as assistant chemist in the St. Louis, Mo., foundry and from 1925 to 1935 was employed as chief chemist and in research for foundry products of gray iron castings and chilled car wheels. In 1935 he was appointed assistant to the manager of foundries, assisting in sales and the production of castings and wheels for all of the company's foundries. He was transferred to New York as sales agent in November, 1944.

◆

PROGRESSIVE WELDER COMPANY.—*P. D. DeLeo* has been appointed development engineer; *I. A. Crawford,* research engineer, and *E. Y. Bunting,* machine design engineer of the Progressive Welder Company, Detroit, Mich.

◆

FRANKLIN RAILWAY SUPPLY COMPANY.—*Julius Kirchhof* has been elected vice-president in charge of engineering for the Franklin Railway Supply Company, with headquarters in New York.

◆

AMERICAN SMELTING & REFINING COMPANY.—*Aubrey M. Callis* has been appointed sales manager of the Whiting, Ind., and Detroit, Mich., plants of the Federated Metals division of the American Smelting & Refining Co. Mr. Callis, formerly assistant general manager of the Pacific Coast department with headquarters at Los Angeles, Calif., has been associated with Federated since 1928 in sales and plant executive capacities.

◆

AMERICAN ROLLING MILL COMPANY; RUSTLESS IRON & STEEL CORPORATION.—*Charles R. Hook,* president of the American Rolling Mill Company and chairman of the board of the Rustless Iron & Steel Corp., has announced that the boards of the two corporations have authorized the preparation of an agreement providing for the merger of Rustless into American Rolling Mill, subject to stockholders' approval. After the merger, to become effective at the year-end, the Rustless plant at Baltimore, Md., will be operated as the Rustless Iron & Steel division.

◆

BETHLEHEM STEEL COMPANY.—*Walter R. Penman,* assistant general manager, has been appointed general manager of the Lebanon, Pa., plant of the Bethlehem Steel Company to succeed *J. H. Edmonds,* who has retired.

◆

SCULLIN STEEL COMPANY.—*B. W. Crenshaw* has been appointed sales representative of the Scullin Steel Company with headquarters in St. Louis, Mo. Mr. Crenshaw has been connected with Scullin Steel since 1941 as works engineer and as assistant works manager.

◆

BAKER-RAULANG COMPANY.—*Lt. Col. H. A. Stevenson,* general staff corps, Army Service Forces, was retired to inactive duty on August 1, and has returned to his former business—the distribution in the Michigan territory of industrial trucks, tractors and cranes of the Baker Industrial Truck Division of the Baker-Raulang Company, Cleveland, Ohio.

◆

UNITED STATES STEEL CORPORATION.—*David F. Austin,* vice-president in charge of sales of the Carnegie-Illinois Steel Corp., and acting vice-president of the United States Steel Corp., has been elected vice-president of sales of the latter company, with headquarters as before at Pittsburgh, Pa.

◆

WEATHERHEAD COMPANY.—*Leonard C. Doolittle* has been appointed industrial hose sales engineer of the Weatherhead Company of Cleveland, Ohio. Major Doolittle recently returned from three years of service in the U. S. Air Corps. Before entering military service he was division sales manager of the Gates Rubber Company at Denver, Colo.

◆

ALLEGHENY-LUDLUM STEEL CORPORATION.—A $5,000,000 postwar research and production expansion program has been approved by the board of the Allegheny-Ludlum Steel Corporation. A research laboratory and related experimental and pilot plant equipment will be built at the company's headquarters, Brackenridge, Pa., and a cold rolling mill will be constructed at the West Leachburg, Pa., plant.

ARDCO MANUFACTURING COMPANY.—*Robert D. Fleischer* has been appointed general sales manager for southern territories in the Ardco Manufacturing Company's newly organized branch, with headquarters at Richmond, Va. Mr. Fleischer served in various capacities with several New York advertising firms and as sales manager for several engineering firms before being appointed to his present position.

◆

AMERICAN BRAKE SHOE COMPANY.—*John S. Hutchins* has been elected president of the Ramapo Ajax Division of the American Brake Shoe Company. Mr. Hutchins began his career with Ramapo Ajax in the operating department in 1925. He was appointed sales manager in 1941 and executive vice-president in October, 1944. J. Brooks Spencer, president of the division,

John S. Hutchins

since 1936, is a vice-president of the Brake Shoe Company. He will handle special assignments in connection with railroad sales for all divisions in addition to his present responsibilities as officer in charge of the company's export division. Headquarters of the Ramapo Ajax division will be transferred from New York to 332 South Michigan Avenue, Chicago.

◆

STANDARD OIL COMPANY OF INDIANA.—Construction has begun on an administration building, general laboratories, and three pilot-plant buildings on recently acquired property in Hammond, Ind. These units will constitute part of new research laboratories which, when completed, will consist of an engine laboratory, a greenhouse for insecticide work, additional pilot-plant buildings, and other research facilities.

◆

WHITCOMB LOCOMOTIVE COMPANY.—*K. O. Nash,* who has been connected with the Whitcomb Locomotive Company since last July, has been appointed St. Louis district manager in charge of sales and service, with headquarters at St. Louis, Mo. Mr. Nash is a graduate of the University of Minnesota. He began his career with the General Electric Company at Erie, Pa., later serving for a brief period as a special apprentice in the mechanical department of the Chicago, Milwaukee, St. Paul & Pacific. In 1927 he was appointed a railway equipment

(Continued on second left-hand page)

IT'S A GREAT NEW DAY FOR RAILROADING

*General Motors
Diesel locomotives
powered 9 of the
fastest start-to-stop
schedules run by
streamlined trains
in the United States
in 1944!

At average speeds of 76.4 to
84 miles per hour!

* According to a table published
recently by the Railway Gazette,
leading English railway trade paper.

ADD SECURITY TO VICTORY ★ BUY MORE VICTORY BONDS

ELECTRO-MOTIVE DIVISION
GENERAL MOTORS CORPORATION • LA GRANGE, ILL.

engineer of the Westinghouse Electric & Manufacturing Co., with headquarters at East Pittsburgh, Pa. Three years later he became resident engineer of the company's South Philadelphia plant, also serving as field engineer. In 1936 Mr. Nash was appointed industrial and transportation sales representative at St. Louis, and in 1940, supervisor of maintenance sales at St. Louis. In 1942 he became a special representative in the railroad division of the Socony-Vacuum Oil Company, the position he relinquished to become associated with the Whitcomb organization.

◆

PHILCO CORPORATION.—*R. D. Birge* has been appointed Detroit, Mich., representative of the Philco Storage Battery division of the Philco Corporation. Mr. Birge is a graduate of Purdue University with a degree in electrical engineering (1938). He has been associated with the Louis Allis Company as field engineer in Detroit for three years and more recently in Philadelphia, Pa., for one year.

◆

INLAND STEEL COMPANY.—*William H. Eichengreen,* assistant manager of the sales promotion division of the Inland Steel Company, has been promoted to manager of the commercial research division which has been created as a new division of the firm's sales department. His headquarters will be in Chicago. Mr. Eichengreen joined Inland Steel in 1931 and spent several years in the company's pricing and sales promotion divisions.

◆

SUPERHEATER COMPANY.—*Walter P. Sebastian,* engine terminal foreman of the Southern railway at Spencer, N. C., has been appointed service engineer of the Superheater Company in the southeast, with headquarters at New York.

◆

SCHAEFER EQUIPMENT COMPANY.—*A. Perry Everstine* has been appointed manager of the Schaefer Equipment Company with headquarters in the company's general offices, Pittsburgh, Pa. *C. W. Wright, Jr.,* has been appointed assistant manager in charge of customer relations in respect to inquiries and orders, also with headquarters at Pittsburgh.

Obituary

ALBERT LINCOLN SALT, retired president and chairman of the board of the Graybar Electric Company, died September 29. He was 80 years of age.

◆

CHARLES H. WILSON, manager of the railroad sales division of Fairbanks, Morse & Co., whose death in Chicago on September 13, was reported in the October issue, was born in Salem, Mass., on May 27, 1884, and attended the Armour Institute of Technology. He entered the sales department of Fairbanks, Morse in 1905, at Chicago. In 1910 he was transferred to Jacksonville, Fla., remaining there until 191[illegible] when he returned to Chicago as a member of the staff of the purchasing department. The following year he went with the International Harvester Company handling sales in northern Illinois. He returned to Fairbanks, Morse in 1913, in the railway sales department, at St. Louis, Mo.; in 192[illegible] was transferred to Chicago, and in 192[illegible] became district manager of railroad sales at St. Louis. Mr. Wilson was appointed manager of railroad sales, with headquarters at Chicago in 1932.

Charles H. Wilson

Personal Mention

General

O. R. BAREFOOT, whose appointment as assistant superintendent motive power, Eastern lines, of the Canadian Pacific at Toronto, Ont., was announced in the October issue, entered the employ of the Canadian Pacific in 1909 as a night foreman at North Bay, Ont. He subsequently served in various capacities at Lambton, Ont., the St. John shops, and at McAdam, N. B., and in 1942 became master mechanic of the Bruce division at Toronto.

O. R. Barefoot

W. P. SULLIVAN has been appointed acting supervisor of Diesel equipment of the Missouri Pacific, with headquarters at St. Louis, Mo.

W. B. BERRY, assistant superintendent of motive power of the St. Louis-San Francisco at Springfield, Mo., has been appointed superintendent of motive power, with headquarters at Springfield. Mr. Berry was born at St. Louis, Mo., on December 13, 1881, and began his railway career as a machinist apprentice in the employ of the Texas & Pacific at Marshall, Tex. He later became a machinist and subsequently served in various capacities ranging from machinist to enginehouse foreman and general foreman on the Missouri Pacific, the Chicago, Rock Island & Pacific, the Missouri-Kansas-Texas, the Southern Pacific, the Trinity & Brazos Valley (now a part of the Chicago, Burlington & Quincy), and the Atchison, Topeka & Santa Fe. In May, 1922, Mr. Berry was appointed master mechanic of the Frisco, with headquarters at Kansas City, Mo., and on August 10, 1935, became assistant superintendent of motive power.

J. D. LOFTIS has been appointed general superintendent motive power of the Atlantic Coast Line, with headquarters at Wilmington, N. C. Mr. Loftis was educated at Utah University and Leland Stanford University. He entered railroading in 1928 with the Denver & Rio Grande Western and remained with that railroad until August, 1942, when he joined the Office of

J. D. Loftis

Defense Transportation, where he served as mechanical assistant, assistant to the director, division of railway transport, and as traffic flow chief, until December, 1943. He then joined the Baldwin Locomotive Works at Cleveland, Ohio, and in August, 1944, became eastern district manager in charge of a new office opened by that company in Philadelphia, Pa. Notice of his recent change of position came on September 29, 1945.

R. H. ROMANN has been appointed acting superintendent of motive power and equipment of the Peoria & Pekin Union, with headquarters at Peoria, Ill., succeeding E. A. Park, who is on leave.

IVAN R. PEASE, assistant superintendent of motive power of the New York, Ontario & Western at Middletown, N. Y., has been appointed superintendent of motive power with headquarters at Middletown. Mr. Pease was born on July 7, 1898, at Wilton, Me. Mr. Pease attended the University of Maine and entered railroading in 1924 as a special apprentice in the employ of the New York, New Haven & Hartford. He subsequently served in the New Haven locomotive shops as gas engine mechanic, foreman of the gas rail car department, and production assistant. From 1931 to 1934 he served with the New England Transportation Company (subsidiary of the New Ha-

Ivan R. Pease

ven) and from 1934 to 1937 with the Universal Motor Mileage Corporation at Boston, Mass. In 1937 he became test supervisor of the New Haven and in 1941 supervisor of apprentices. Later in 1941 Mr. Pease was appointed assistant to superintendent motive power of the N. Y., O. & W. and in 1942 assistant superintendent motive power of the N. Y., O. & W. and the New York, Susquehanna & Western.

THOMAS H. EVANS, shop superintendent of the Missouri-Kansas-Texas at Waco, Tex., has been appointed chief mechanical officer, with headquarters at Parsons, Kan.

F. E. RUSSELL, chief mechanical engineer of the Southern Pacific, with headquarters at San Francisco, Cal., has retired after 46 years of service.

V. J. CROSSLEY, master mechanic of the Bamberger Railroad, has been appointed to fill the newly created position of train master at Salt Lake City, Utah.

L. A. PORTER, assistant general superintendent motive power of the Seaboard Air Line, has been appointed to the newly-created position of chief mechanical officer with headquarters as before at Norfolk, Va. Mr. Porter was born on October 17, 1899, in Culpeper County, Va. He is a graduate of Virginia Polytechnic Institute

L. A. Porter

(1910) and attended the University of Edinburgh in 1919. He began his career in August, 1910, as a clerk and draftsman in the employ of the Seaboard Air Line, then worked successively, from 1912 until 1916, for the United States Steel Corporation and the Richmond Cedar Works. He returned to the Seaboard Air Line in 1916 as a draftsman. During World War I Mr. Porter was a captain in the United States Army serving with the American Expeditionary Forces. From 1919 until 1922 he was employed at the U. S. Navy Yard, Norfolk, Va. In the latter year he again returned to the Seaboard Air Line as a draftsman. In 1926 he became chief draftsman, in 1936, mechanical engineer, in 1942, assistant to the general superintendent motive power, and in 1944 to assistant general superintendent motive power.

S. D. DEKLE, assistant general superintendent motive power of the Seaboard Air Line, has been appointed assistant chief mechanical officer with system jurisdiction, with headquarters as before at Jacksonville, Fla.

GEORGE FERGUSON, air-brake instructor, Central region, of the Pennsylvania, has been appointed general air brake inspector, Central region, with headquarters at Pittsburgh, Pa.

OTTO C. GRUENBERG has returned to his position as superintendent of motive power of the New York, Susquehanna & Western. Mr. Gruenberg, holding the rank of major, had been serving as a transportation officer in the United States Army for the past three years.

W. G. MCPHERSON, whose retirement as assistant superintendent motive power, Eastern lines, of the Canadian Pacific at Toronto, Ont., was announced in the October issue, entered railroading with the Canadian Pacific on November 13, 1901, as a fitter at Revelstoke, B. C. He subsequently served at Cranbrook, B. C., and Calgary, Alta., until February 21, 1910, when he became locomotive foreman at Hardisty, Alta. After being located at several points in western territory, he was appointed district master mechanic at North Bay, Ont., on January 1, 1929. On June 1, 1935, he was appointed assistant superintendent motive power, at Montreal, Que., and in May, 1937, was transferred to Toronto.

W. H. GIMSON, master mechanic of the St. Louis-San Francisco at Tulsa, Okla., has been appointed assistant superintendent of motive power, with headquarters at Springfield, Mo. Mr. Gimson was born at Memphis, Tenn., on September 13, 1887, and entered railway service with the Frisco as a machinist apprentice in September, 1904, at Memphis. Later he served as enginehouse foreman at Memphis and on March 1, 1917, was appointed division foreman, with headquarters at Harvard, Ark. Later in the same year Mr. Gimson became general foreman at Monett, Mo. On August 15, 1929, he was appointed shop superintendent at Tulsa, Okla., and on January 1, 1941, he became master mechanic at Tulsa.

HENRY W. JARRETT, master mechanic of the Seaboard Air Line at Savannah, Ga., has been appointed assistant to chief mechanical officer, with headquarters at Norfolk, Va.

Master Mechanics and Road Foremen

W. P. PRIMM has been appointed road foreman of engines of the Pennsylvania, with headquarters at Toledo, Ohio.

RICHARD F. BENTON has been appointed master mechanic of the Bamberger Railroad, with headquarters at North Salt Lake City, Utah.

L. M. WINSLADE, locomotive foreman in the employ of the Canadian Pacific at Lambton, Ont., has been appointed division master mechanic, Montreal Terminals division with headquarters at Montreal, Que.

W. C. FLECK has been appointed assistant master mechanic of the Ft. Wayne division of the Pennsylvania, with headquarters at Ft. Wayne, Ind.

D. J. EVERETT, master mechanic of the Gulf division of the Gulf, Colorado & Santa Fe at Galveston, Tex., has been transferred to the Southern division, with headquarters at Temple, Tex.

F. M. MOZLEY, master mechanic of the Southern division of the Gulf, Colorado & Santa Fe at Temple, Tex., has been transferred to the Gulf division, with headquarters at Galveston, Tex.

J. H. BURGER, assistant master mechanic of the Illinois Central at Markham, Ill., has been appointed master mechanic, with headquarters at Champaign, Ill.

THOMAS MURRAY, general foreman of the St. Louis San Francisco at North Springfield, Mo., has been appointed master mechanic with headquarters at Tulsa, Okla.

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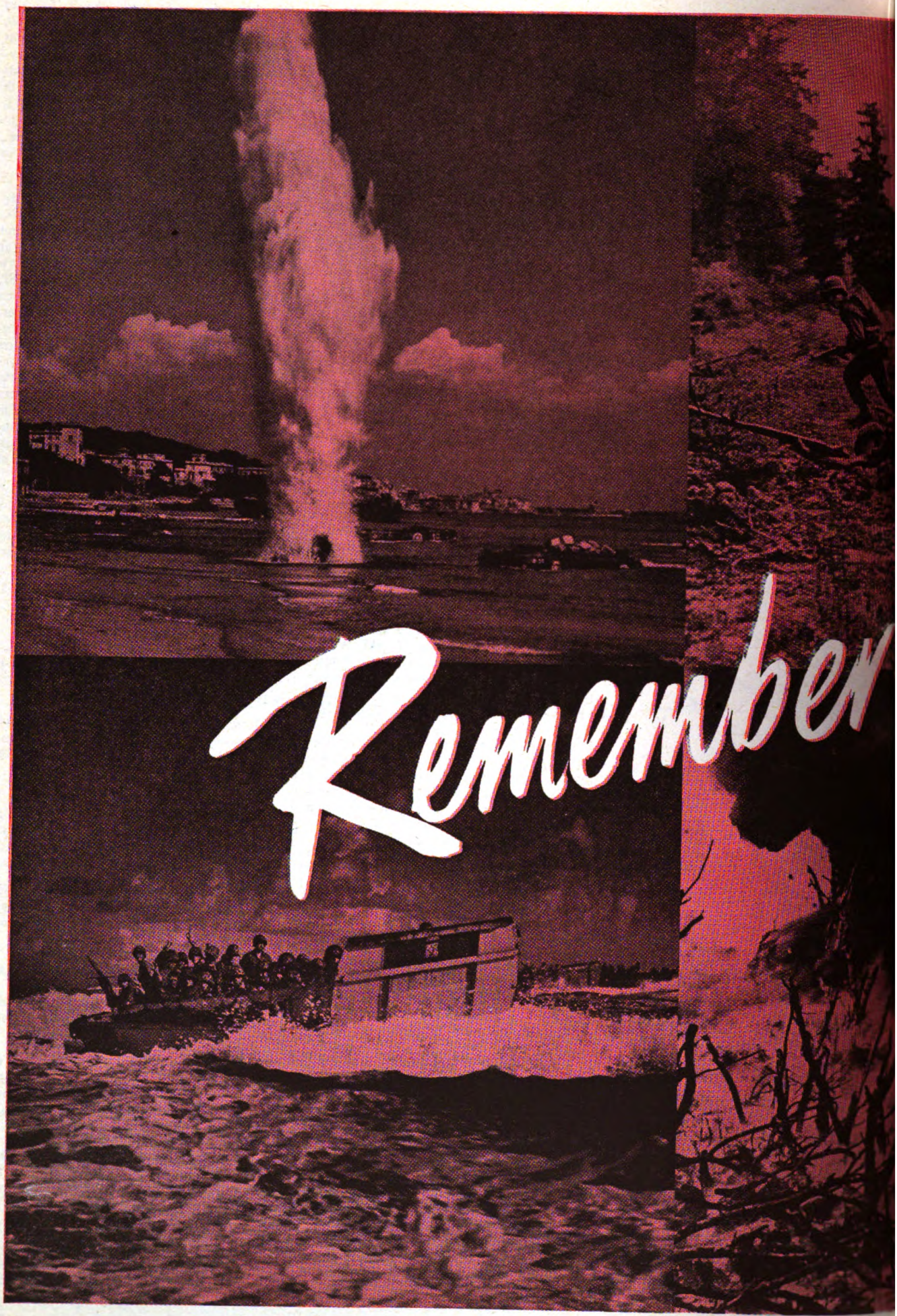
Remember

Kasserine Pass, Anzio, Saint-Lô, the Remagen Bridge...

Guadalcanal, Attu, Bougainville, Tarawa, Iwo, Okinawa...

Remember?

Already, the names grow a little hazy to some of us. But men died there, and more were hurt, and some managed to come through.

They had a tough job to do...and they did it. *You* remember.

There's something called a debt we owe... to several million men who finished the biggest job this country ever tackled...

A debt to men who fought and were wounded—and still need the best medical attention in the world. To men who are scattered all over the globe—and still need return-trip tickets. To men who are coming out of uniform—and need a hand to get started again.

You can help pay our debt to these men—by buying Victory Bonds. Bonds—not to give them weapons this time, but to give them back their world. That's the job *you're* asked to finish—by buying extra bonds for the last time.

Kasserine Pass... Anzio... Okinawa...

How good is your memory?

Victory

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Loan

They Finished Their Job
Let's Finish Ours!

CONTRIBUTED BY
AMERICAN LOCOMOTIVE COMPANY

P. H. VERD has been appointed master mechanic of the Gary division of the Elgin Joliet & Eastern, with headquarters at Gary, Ind.

P. J. JOHNSON, division master mechanic of the Canadian Pacific at Montreal, Que., has been appointed district master mechanic, with headquarters at Montreal.

Electrical

F. W. REED, electrical engineer of the Northern Pacific at St. Paul, Minn., has retired.

R. C. SORENSON has been appointed electrical engineer of the Northern Pacific, with headquarters at St. Paul, Minn.

EARL C. MASON, recently released from the Army in which he served as captain, Transportation Corps, has been appointed assistant superintendent electrical equipment department, New York Central, with headquarters at Harmon, N. Y.

Car Department

A. H. FAERBER, superintendent of shop of the New York Central at East Buffalo, N. Y., has retired after more than 40 years of service.

C. N. KITTLE, division general car foreman of the New York Central at Buffalo, N. Y., has been appointed superintendent of shop at East Buffalo, N. Y.

Shop and Enginehouse

JOHN B. REESE, general shop foreman of the Missouri-Kansas-Texas at Waco, Tex., has been appointed shop superintendent at Waco.

A. C. STACKMAN, gang foreman at the Pitcairn, Pa., enginehouse of the Pennsylvania, has been appointed enginehouse foreman at Shire Oaks, Pa., Monongahela division.

Obituary

FRANK W. THOMAS, retired supervisor of apprentices of the Atchison, Topeka & Santa Fe, died in Topeka, Kan., on September 13, 1945, as noted in the October issue. Interment took place at Roanoke, Va. In 1907, when the Santa Fe decided to enlarge and extend its apprentice training facilities, Mr. Thomas, then engineer of tests, was made supervisor of apprentices. Within the next few years a training system was developed which achieved a wide reputation for its thoroughness and high standards. Not only did it supply well-trained craftsmen, but it was the training ground of many of the present mechanical officers of the Santa Fe. Mr. Thomas retired in 1932.

F. G. LISTER, superintendent of motive power of the St. Louis-San Francisco, with headquarters at Springfield, Mo., died in a Tulsa, Okla., hospital on August 20. Mr. Lister was born at Marysville, Kan., on July 8, 1882, and studied for two years at the University of Nebraska. His first railway service was with the Wabash in 1901, as a special apprentice, becoming a mechanical draftsman a short time later. In 1906, Mr. Lister went with the Northern Pacific as a locomotive and car draftsman, and five years later became chief draftsman and mechanical engineer of the Spokane, Portland & Seattle and affiliated lines. In 1916 he became mechanical engineer of the El Paso & Southwestern (now part of the Southern Pacific); in 1924, master car repairer on the Southern Pacific, at El Paso, Tex., and in 1926 chief mechanical officer of the St. Louis-San Francisco. On January 1, 1931, he was appointed assistant superintendent of motive power, and two years later superintendent of motive power.

ALBERT J. KRUEGER, general superintendent car department of the New York, Chicago & St. Louis at Cleveland, Ohio, died suddenly on October 13. Mr. Krueger was born in Toledo, Ohio, on June 26, 1890. He began his railroad career in 1912, serving successively in the employ of the Lake Shore & Michigan Southern (now New York Central) as clerk and car repairman at Air Line Junction, Ohio; inspector at Erie, Pa., and piecework inspector at Air Line Junction. In 1913 he became contract inspector for the Michigan Central at Chicago Heights, Ill., and in 1914 assistant general shop inspector of the Lake Shore & Michigan Southern at Collinwood, Ohio, and Englewood, Ill. He entered the employ of the New York, Chicago & St. Louis in 1916 as general shop inspector at Cleveland, and in 1921 was appointed master car builder with headquarters at Cleveland. From 1933 to 1937 he was general car foreman at Conneaut, Ohio. In the latter year he became inspector car department of the Chesapeake & Ohio, Pere Marquette, and the New York, Chicago & St. Louis at Cleveland. He was appointed superintendent of the car department of the New York, Chicago & St. Louis at Cleveland in January, 1938, and general superintendent car department in 1943. Mr. Krueger had been active in the work of the Car Department Officers' Association for many years. In 1941 he was elected president of the association and in 1942 again took over and had since continued the duties of president, acting for F. E. Cheshire, who had entered military service. He was also a member of the Western Railway Club, the Central Railway Club, and the Car Department Association of St. Louis.

A. J. Krueger

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

VERTICAL TURRET MILLS.—Rogers Machine Works, Inc., 1807 Elmwood avenue, Buffalo 7, N. Y. 12-page illustrated booklet describing the Rogers "Perfect 36" vertical turret mills for boring, drilling, and turning.

◆

FASTENING DEVICES.— Parker-Kalon Corporation, 208 Varick Street, New York 14. Sixth edition of Parker-Kalon catalog contains new information on their many types of self-tapping screws, socket screws, and other fastening devices, with illustrated instructions on where and how to use.

◆

PALMETTO PACKINGS.—Greene, Tweed & Co., Bronx boulevard at Two Hundred and Thirty-eighth street, New York 66. Bulletin P-3 contains condensed descriptions of each grade of Palmetto packing, with illustrations and an application chart for self-lubricating packings.

◆

MAGNETIC INGOT IRON.—American Rolling Mill Company, Middletown, Ohio. Twenty-four page booklet, "Armco Magnetic Ingot Iron for D. C. Applications," illustrated with charts. Section on How to Fabricate Magnetic Ingot Iron contains data on effect of strains on magnetic properties; hot and cold working; machining operations with the aid of standard tools and accepted methods of welding, including tables on best electrodes to use. The iron is described as a highly refined open-hearth iron with high conducting power for use as magnetic cores for cyclotrons to telephone and telegraph wires for communication systems and as a conductor of current in various kinds of electrical transportation equipment.

◆

MANGANESE STEEL.—American Brake Shoe Company, American Manganese Steel Division, Chicago Heights, Ill. Thirty-two page Bulletin, No. 1144-NM, entitled "Non-Magnetic Applications for Amsco Manganese Steel," presents studies, with illustrations, of typical applications. Discusses Amsco production and research facilities, what manganese steel is, how it was discovered, etc.

◆

CINCINNATI SHAPERS.—The Cincinnati Shaper Co., Cincinnati 25, Ohio. General Catalog N-3. Describes and illustrates, in color, the five types of Cincinnati shapers—Rapid Traverse, Universal, Utility, High-Speed, and Railroad types. The sizes described in the section on Railroad shapers, which is entirely new, are 32-in. and 36-in. heavy-duty Rapid Traverse types equipped with special features for emergency work on driving boxes, crossheads, shoes and wedges, main rod brasses, and other general repair and maintenance work in railroad shops.

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Railway Mechanical Engineer

December 1945

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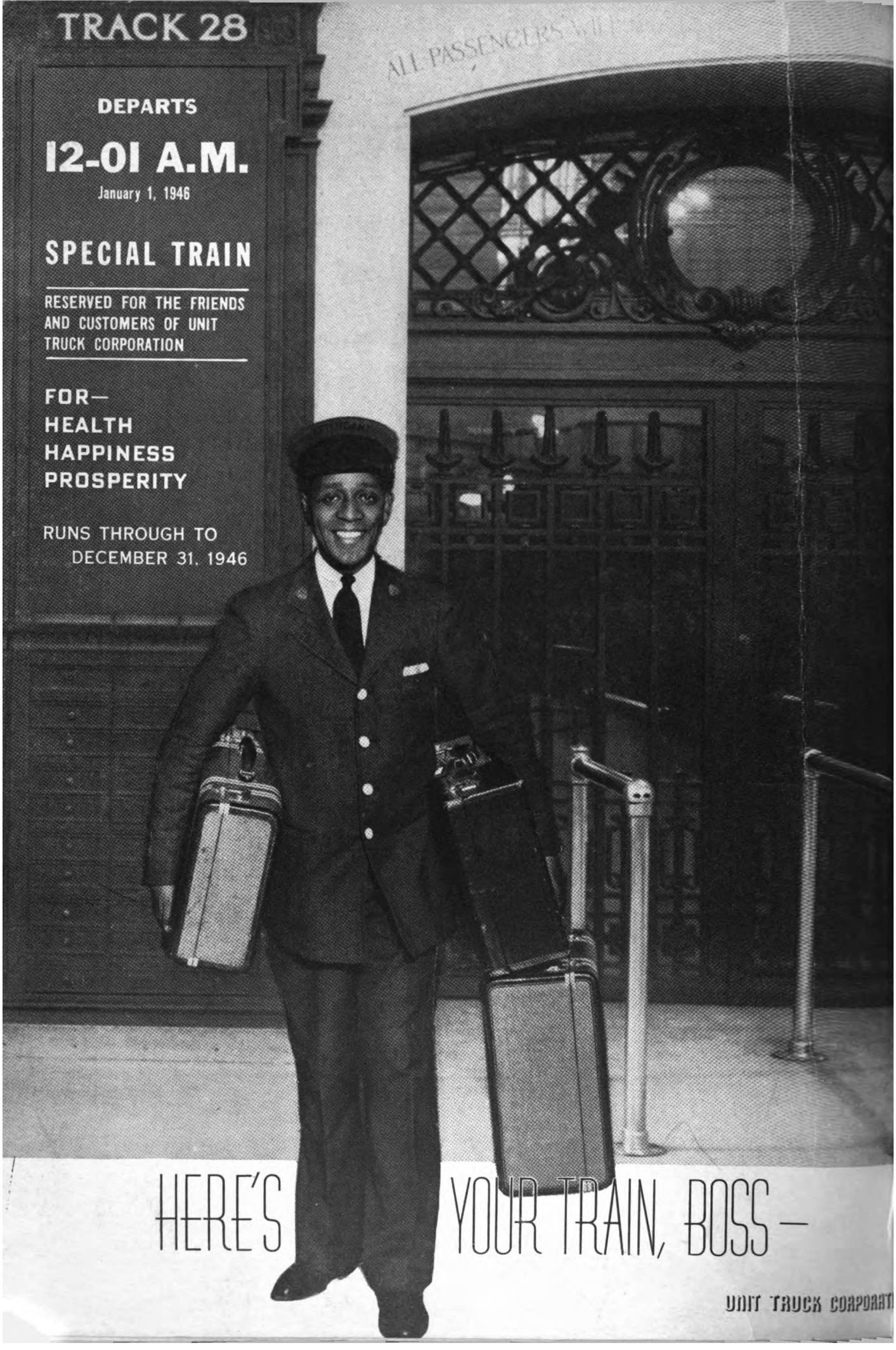
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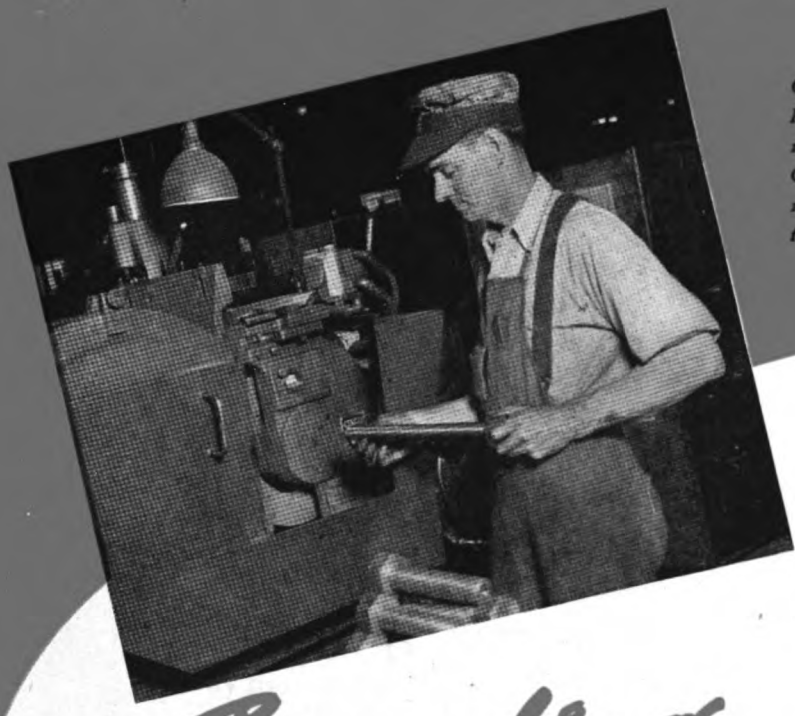

Complete specifications on CINCINNATI *No. 3 Centerless Grinding Machines may be obtained by writing for Catalog G-438-3. For a brief description of these machines, look in Sweet's Catalog File for Mechanical Industries.*

Grinding FRAME BOLTS

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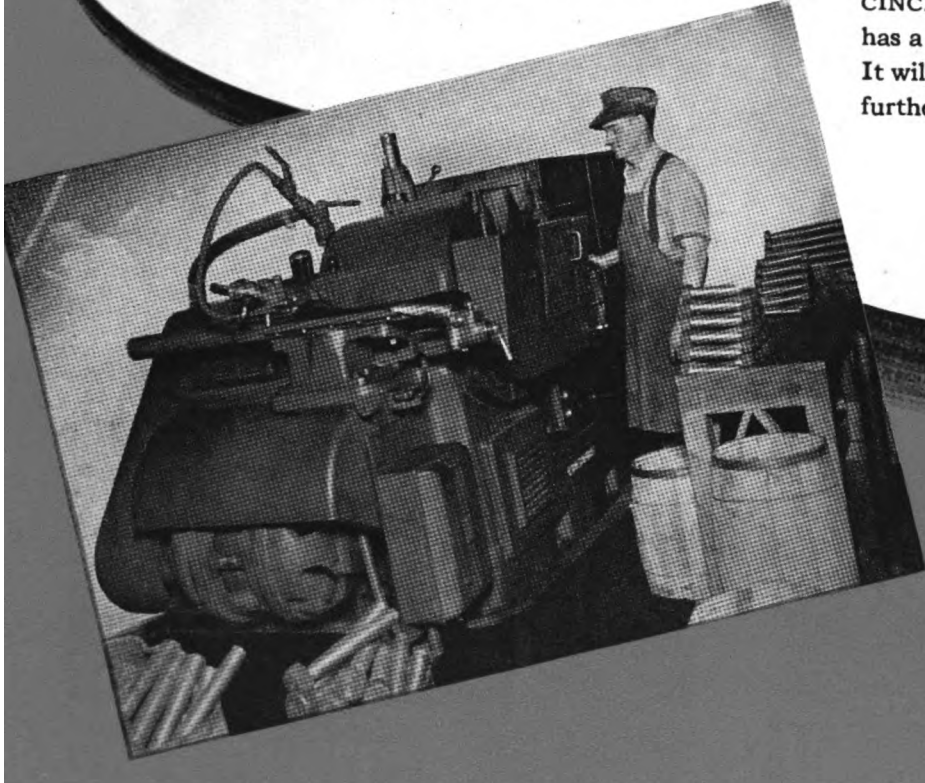
● These illustrations show a CINCINNATI No. 3 Centerless set up for grinding frame bolts by the infeed method. The complete length of the bolt under the head is ground to size in one operation. ¶ There are several reasons for using a No. 3 Centerless for jobs of this type. It is potentially a high production machine, yet it has a number of features to facilitate setup. Heavy duty construction permits unusually wide contact between work and wheel; FILMATIC grinding wheel spindle bearings withstand heavy cuts with no special attention; hydraulic profile truing over both wheels facilitates and speeds up the truing and dressing of the wheels; large diameter infeed handwheel with micrometer adjustments gives you diameter reduction as fine as .0001". ¶ The CINCINNATI No. 3 Centerless Grinder has a very definite place in railway shops. It will be to your advantage to investigate further.



Write for booklet G503-1 "Principles of Centerless Grinding," an unusually informative booklet which is written in nontechnical language. This booklet also contains a chapter on small lot production.

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Western Maryland Shay

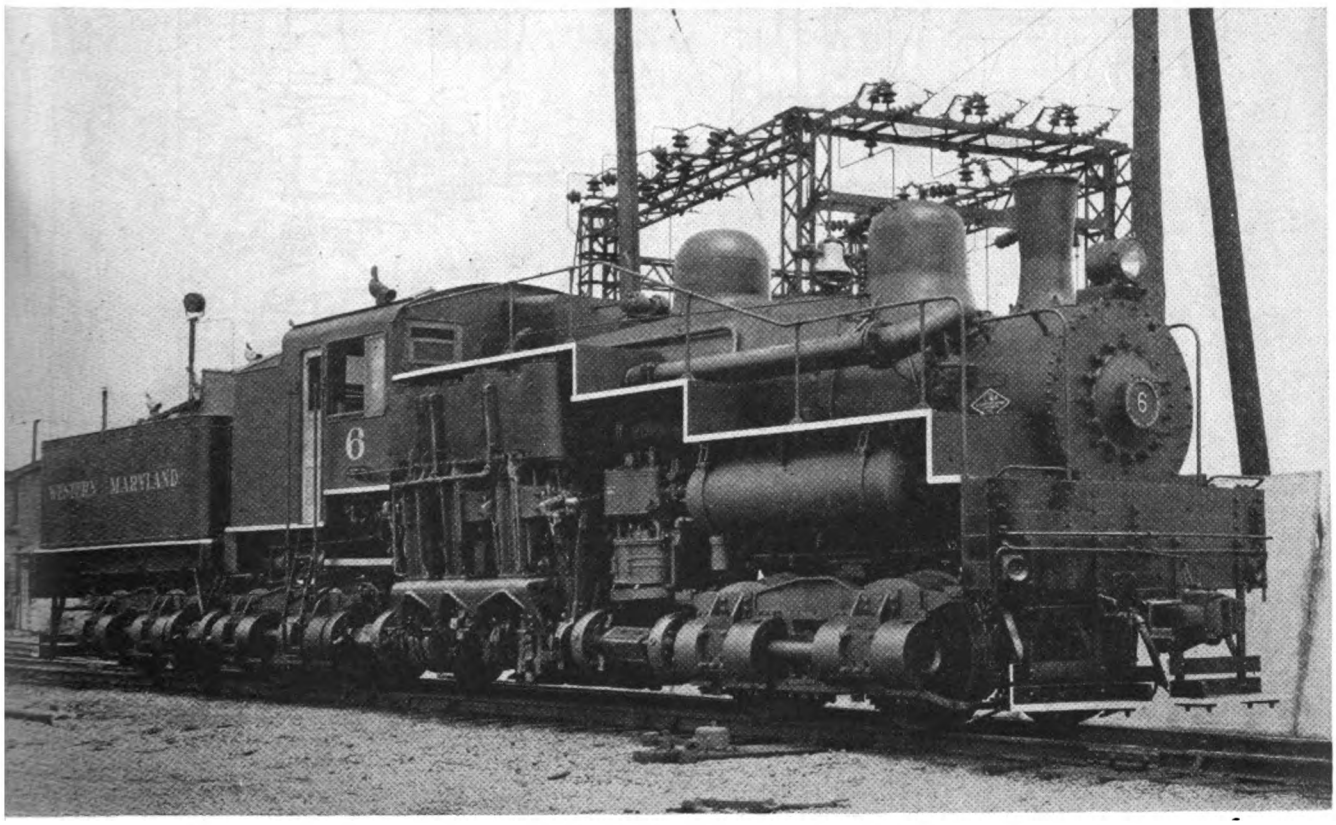
Lima-built geared locomotive having a tractive force of 59,740 lb. and a total weight of 324,000 lb. is designed for operation on 7 per cent grades and 22 deg. curvature

THE Lima Locomotive Works has recently delivered to the Western Maryland a Shay geared locomotive having a total weight of 324,000 lb. and a tractive force of 59,740 lb. This locomotive is designed for regular operation on 7 per cent grades with occasional stretches up to 10 per cent with maximum curvatures up to 22 deg. The trailing loads that can be handled at various speeds and on different grades are shown in an accompanying table. It is used on a coal-mining branch that connects with the Western Maryland near Chaffee, W. Va., between Cumberland, Md., and Elkins, W. Va., and is located on the headwaters of the Potomac river. The branch, originally a narrow gage, was built in 1904 by the Three Forks Coal and Coke Company and was converted into a standard gage in 1912. The Western Maryland acquired the branch line in 1929 and has operated it since that time.

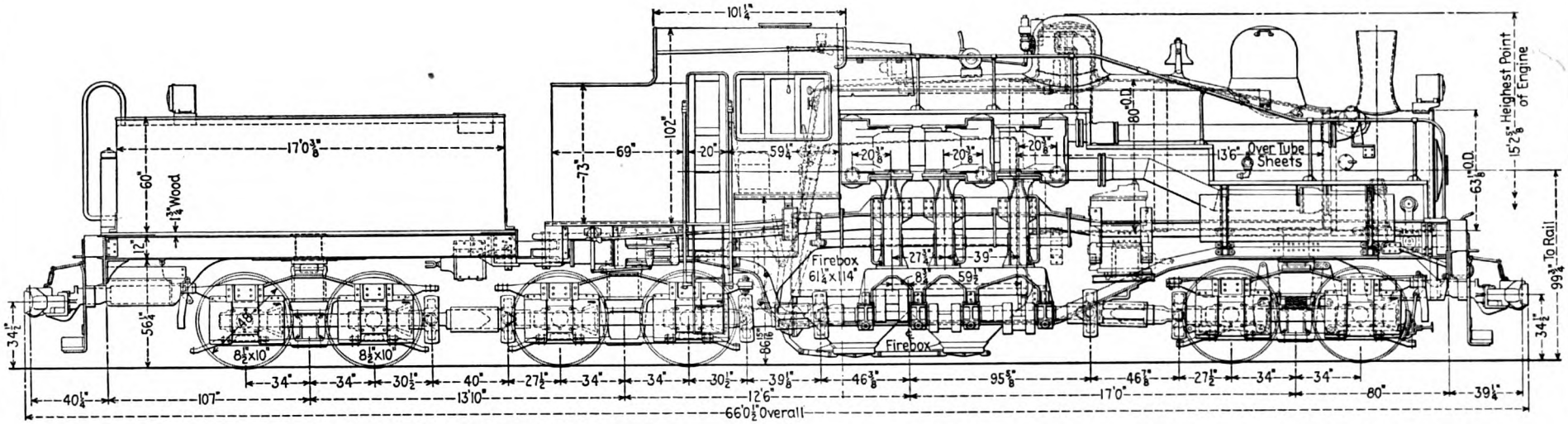
The Boiler

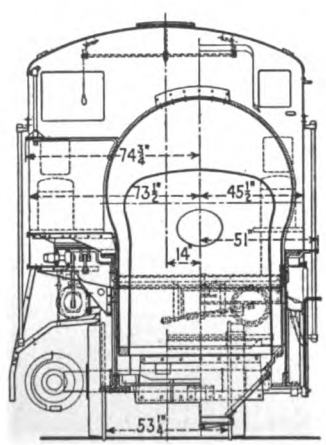
Conventional design and construction characterizes the boiler of this locomotive. It is a two-ring extended wagon top type, 28 ft. 3 in. long overall. The first of the two shell rings is 62⅜ in. outside diameter at the front tube sheet and tapers to 80 in. at the second-ring circumferential seam. The barrel plates are ¾ in. thick and the longitudinal seams are the triple-riveted butt type with the barrel plate seam welded. The dome, 29 in. inside diameter, is located on the second ring.

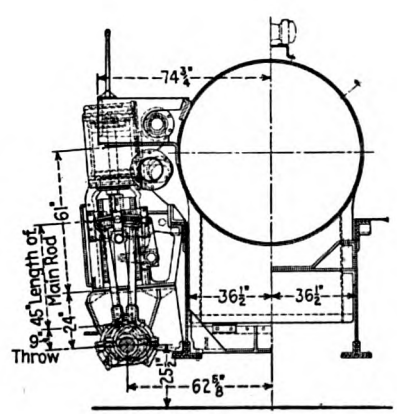
For regular operation on seven per cent grades, the fireboxes are built with a 30-in. space between crown and roof. Double water glasses are used with the low reading 3½ in. above the highest point of the crown and the high reading 21 in. above that point.

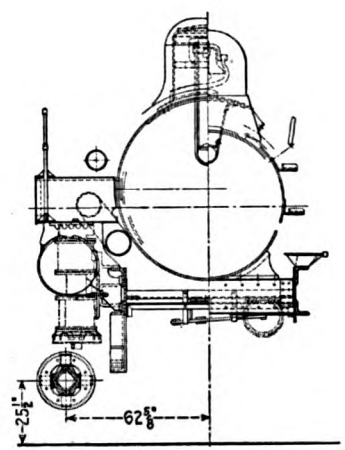


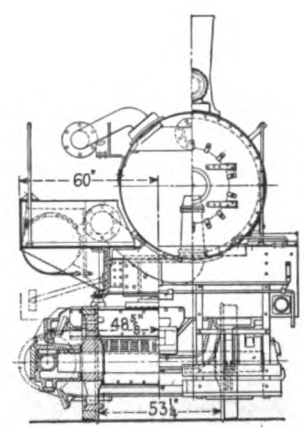
Right side of the locomotive showing the three-cylinder vertical engine and the drive shaft arrangement











Elevation and cross-sections of the Western Maryland Shay geared locomotive

eneral Dimensions and Weights of the Western Maryland Shay Locomotive

ilder	Lima Locomotive Works
te built	1945
ad number	6
eam pressure, lb. per sq. in.	200
ivers, diameter, in.	48
linders, number, diameter and stroke, in.	(3) 17 x 18
ted tractive force, engine, lb.	59,740
lve gear, type	Stephenson
lves, piston, diameter, in.	9
aximum travel, in.	4¾
eam lap, in.	1
haust clearance, in.	Line and line
ad, in.	¼ at 50 per cent cut-off 1/16 in full gear
t-off in full gear, per cent	81.4
mensions:	
Height, rail to top of dome, ft.-in.	15—2⅛
Height, rail to center of boiler, ft.-in.	8—3¼
Width overall, ft.-in.	11—4
Length over engine and tender, ft.-in.	66—0½
heel bases, ft.-in.:	
Driving	49—0
Engine, total	35—2
Engine and tender, total	49—0
Truck wheel base, rigid	5—8
eights, lb.:	
Drivers	324,000
Engine, total	324,000
eight on drivers, per cent weight of engine	100
eight on drivers ÷ tractive force	5.42
ender:	
Style or type	Rectangular
Water capacity, U. S. gal.	6,000
Fuel capacity, tons (in cab)	9

The firebox is built without a combustion chamber and s 114 in. long by 61¼ in. wide inside. The side and roof heets, as well as the furnace crown and side sheets, are ach one piece and the firebox seams are riveted. The urnace door sheet and back head are welded at the loor ring.

Flannery flexible staybolts are used in the firebox reaking zones and the outside row of throat sheet stays. Several rows of Flannery rigid hollow stays are used in he area above the mud ring and fire line. Three 3-in. rch tubes support the Security brick arch. Bituminous oal is hand fed through a Franklin No. 8A firedoor.

The boiler is equipped with two Sellers No. 10½ injectors having a combined capacity of 7,900 gallons per hour, Type A superheaters, 2-in. Okadee blow-off cocks, and two 3-in. Ashton safety valves.

The main steam pipe from the header to the engine cylinders is located outside the boiler on the right side and is of cast iron with ball joints. The throttle dry pipe is similarly equipped. The engine exhaust pipe is located next to the boiler on the right side and enters the smokebox on the bottom center line.

Frames and Machinery

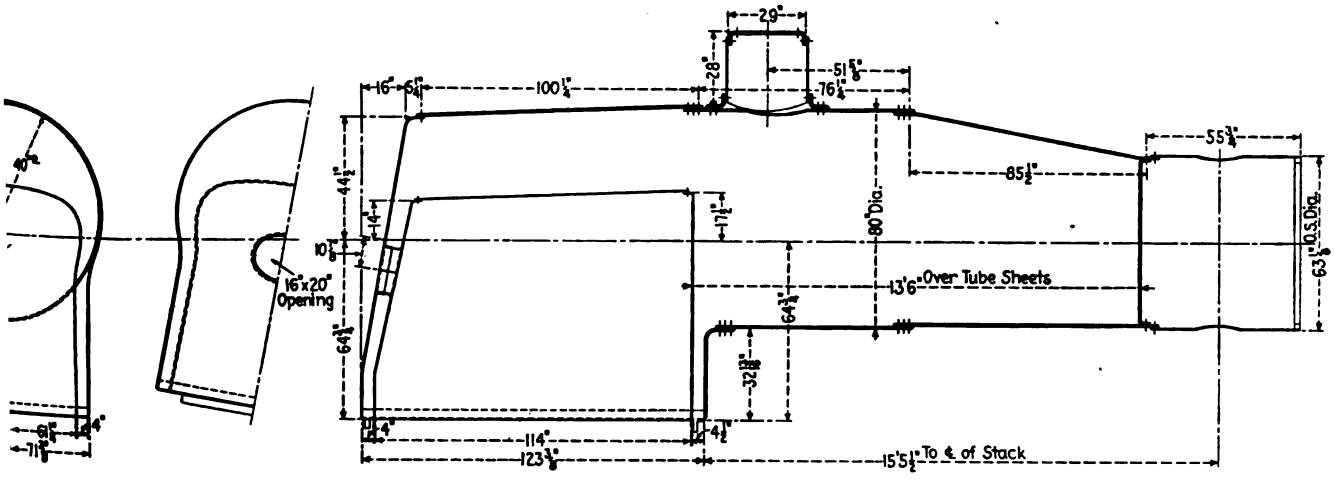
The main locomotive frame is a girder type assembly fabricated, by riveting, of plate and angles. The top rail is a 6-in. by 8-in. by 1-in. angle and the bottom rail is built up of two 6-in. by 6-in. by 1-in. angles with a 1-in. cover plate. The vertical web is ¾-in. plate on the right frame and ⅝ in. on the left frame. The side frame rails are tied together by the bumper and foot plate crossties as well as cross members at the front truck bolster and at the front of the firebox. Brackets for runboards, air compressor and air reservoirs are bolted to the frame. The center line of the boiler is located 14¾ in. to the left of the center of the track rails. This compensates for the machinery location on the right side of the locomotive.

The machinery and running gear consists of a three-

Hauling Capacity of 150-Ton Shay Locomotive

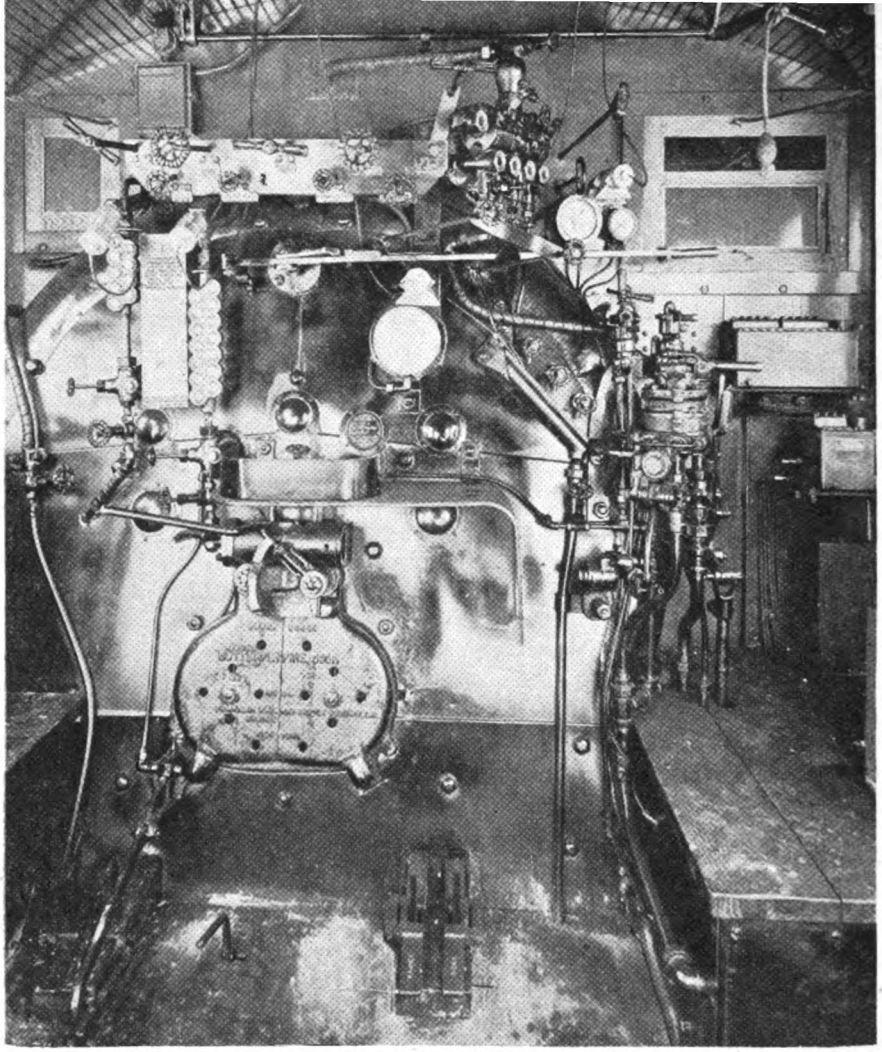
Speed, m.p.h.	Tractive force	Drawbar pull, lb. on level	Drawbar pull, lb. 5 per cent grade	Drawbar pull, lb. 7 per cent grade	Hauling capacity, tons on level	Hauling capacity, tons 5 per cent grade	Hauling capacity, tons 7 per cent grade
2	59,740	58,940	43,540	37,540	7,370	404	254
4	59,000	58,200	42,000	36,800	7,280	396	249
6	56,800	56,000	40,600	34,600	7,000	376	234
8	50,900	50,100	34,700	28,700	6,260	322	194
10	45,300	44,500	29,100	23,100	5,560	270	156
14	35,400	34,600	19,200	13,200	4,330	178	89
18	28,400	27,600	12,200	6,200	3,450	113	42
20	25,500	24,700	9,300	3,300	3,090	86	22
22	23,200	22,400	7,000	1,000	2,800	65	7

General Dimensions of the Boiler

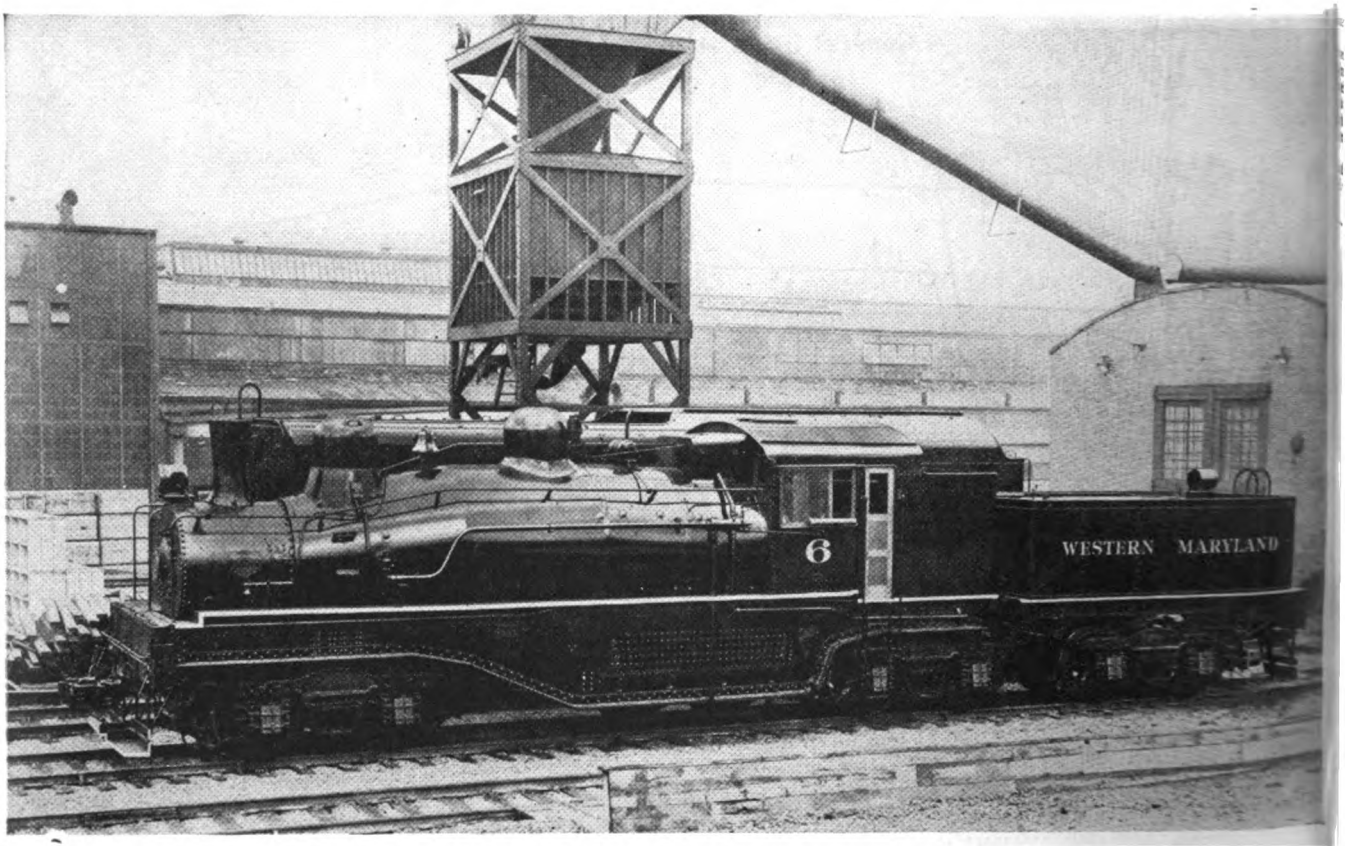


team pressure, lb.	200
iameter first ring, outside, in.	Conical 62¾ min.
iameter second ring, inside, in.	78½
iameter second ring, outside, in.	80
heet thickness, in.:	
Smokebox	5/16
First ring	7/16
Second ring	7/16
Back head	5/16
Side sheets	11/32
Roof sheet	11/32
Furnace door sheet	5/16
Furnace side sheets	5/16
Furnace crown sheet	5/16
Combustion chamber	None
Front tube sheet	9/16
Back tube sheet	½

Firebox length, in.	114
Firebox width, in.	61¼
Water space, front, in.	4½
Water space, back, in.	4
Water space, sides, in.	4
Arch tubes, number and diameter, in.	(3)—3
Tubes, number and diameter, in.	(156)—2
Flues, number and diameter, in.	(28)—5⅜
Length over tube sheets, ft.-in.	13—6
Superheater, type	A
Fuel	Bituminous
Grate area, sq. ft.	48.5
Heating surfaces, sq. ft.:	
Firebox and arch tubes	226
Tubes and flues	1,623
Evaporative, total	1,849
Superheater	429
Combined evap. and superheat.	2,278



The cab affords plenty of working room and is of the vestibule type



The left side has a clean cut appearance—the frame construction is visible

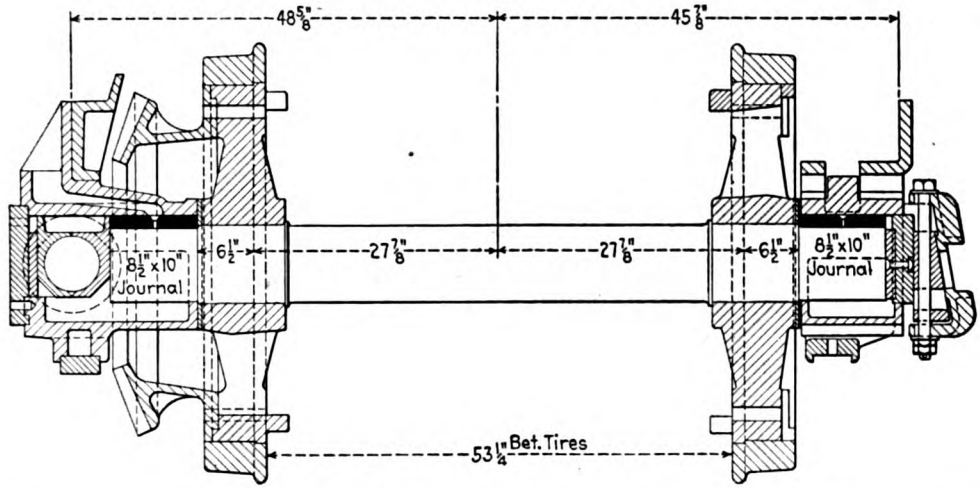
cylinder, single-expansion engine located on the right side immediately ahead of the cab. Directly connected to the engine crank shaft is a line shaft assembly which transmits power to three four-wheel trucks, alike in essential details and dimensions. Two of the trucks are located under the locomotive, on centers of 29 ft. 6 in., and one under the tender 13 ft. 10 in. back of the center of the rear engine truck.

The Three-Cylinder Engine

The engine is a vertical three-cylinder single-expansion unit with piston valves and Stephenson valve gear. The cylinders are 17 in. bore and 18 in. stroke. Steam distribution is effected by 9 in. piston valves operating in bushings with a 4¾-in. maximum travel. The valve gear is controlled by an Alco Type G power reverse gear through double reverse cranks located in planes at right angles to each other. The reverse shaft bearings are embodied in the vertical engine frames.

The pistons are cast iron with 3½-in. hammered-steel rods secured by a taper fit to cast-steel crossheads operating in cast-iron guides in the engine frame. The forged connecting rods have brasses with two babbitt strips in each half and are adjustable at both crosshead and crank shaft ends. The crank shaft is 7¼ in. in diameter with 7¼-in. by 7-in. journals. The shaft is supported by four main bearings in the bed plate with removable bearing caps and brass bearings.

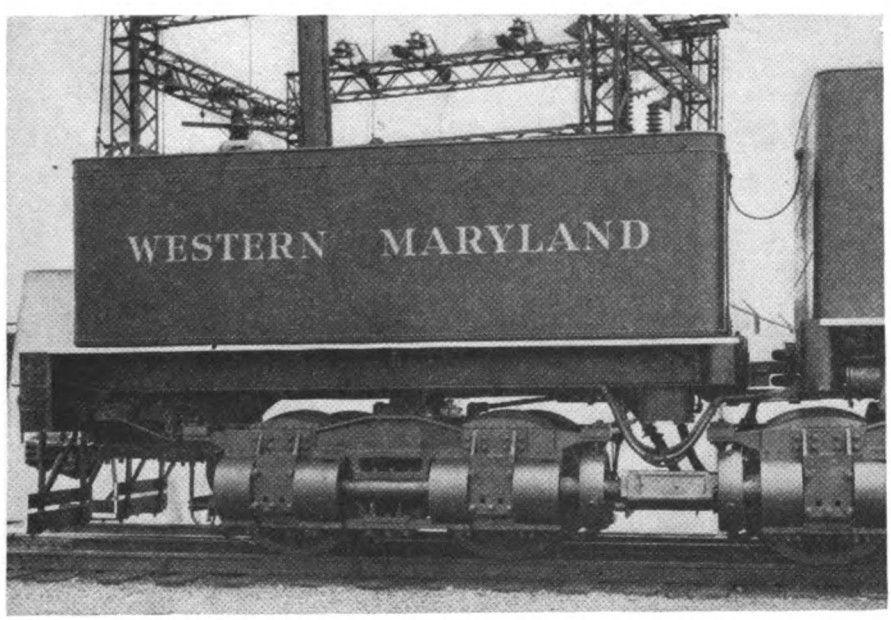
The backbone of the engine assembly is a steel bed casting to which three separate vertical engine frames containing the crosshead guides are bolted. The lower ends of these vertical frames are flanged to form the pads of the bed connection and the upper ends are flanged for the cylinder connection.



Cross section of one of the truck wheels showing the journal bearings, line shaft bearings and the mounting of the driving gear on the steel-tired wheel

Partial List of Materials and Equipment on the Western Maryland Shay Locomotives

Firedoor	Franklin Railway Supply Co., Inc., New York.
Couplers	W. H. Miner, Inc., Chicago.
Brake Equipment	Westinghouse Air Brake Co., Wilmerding, Pa.
Gage cocks; lubricators; whistle	Nathan Manufacturing Co., New York.
Blow-off cock	The Okadee Co., Chicago.
Steam gage	Ashcroft Gauge Div., Manning, Maxwell, & Moore, Inc., Bridgeport 2, Conn.
Safety valves	Ashton Valve Co., Boston, Mass.
Water glass	Hanlon Drifting Valve Co., Boston, Mass.
Power reverse gear	American Locomotive Co., New York.
Lubrication	Manzel Bros. Co., Buffalo 10, N. Y.
Superheater	The Superheater Co., New York.
Brick arch	American Arch Co., Inc., New York.
Staybolts	Flannery Bolt Co., Bridgeville, Pa.
Injectors and checks	Wm. Sellers & Co., Inc., Philadelphia, Pa.
Headlight; generator	The Pyle-National Co., Chicago.
Bell ringer	U. S. Metallic Packing Co., Philadelphia, Pa.



The tender tank is supported at two points—The truck and the hinge connection to the engine

On each vertical engine frame is a cast-steel valve-motion support containing the valve crosshead guide. These valve-motion supports are bolted to the side members of the vertical engine frames and act as strength members.

The cylinders and piston-valve chambers are cast as integral units and may be removed separately from the vertical engine frames. Both the engine bed plate and vertical frames are rigidly bolted to the locomotive girder frame at the top and bottom frame rails.

The line shaft which transmits power to the trucks has three pairs of universal couplings; one pair between the tender and rear engine truck; one pair between the rear engine truck and the rear of the engine crank shaft, and one pair between the front of the engine crank shaft and the front engine truck. Each coupling consists of two forked ends, or horns, forming a universal joint. The horn ends operate in bushings in the coupling ring. Removable cellars containing oil fittings are used at the four horn ends. Slip joints of square cross section, between each pair of couplings, permit truck swing adequate to negotiate 22-deg. curves. The horn couplings are cast steel, shrunk on and keyed.

Trucks and Drive Mechanism

The three four-wheel trucks have cast-steel side members and forged truck-box binders. At each truck there are body and truck bolsters consisting of a pair of 12-in. 40-lb. channels with 1⅛-in. cover plates. Coil springs, 36 in number, between the bolsters, carry the load.

Six of the 12 truck wheels, on the right side, have cast-steel wheel centers of special design to accommodate the rim of the drive gear on the outside of the wheel and with lugs cast on the inside to prevent shearing the gear holding bolts in case of derailment. Steel tires are shrunk onto the wheel centers. The six left-side wheels are rolled steel. All wheels are 48 in. diameter and are mounted on carbon steel axles with 8½-in. by 10-in. journals running in oil-lubricated bronze-bearing truck boxes. The truck boxes on the right side are a special design which incorporates both the journal bearings for the axles and the bearings for the pinion, or line shaft. These are at right angles to each other. The line shaft bearings are 6½ in. by 14 in. The pinions are located ahead of each axle and are keyed to the line shaft. The gear ratio is 2.45 to 1 with 20 teeth on the pinion and 49 teeth on the gear. The maximum locomotive speed is 22 m.p.h. at a maximum engine speed of 377 r.p.m.

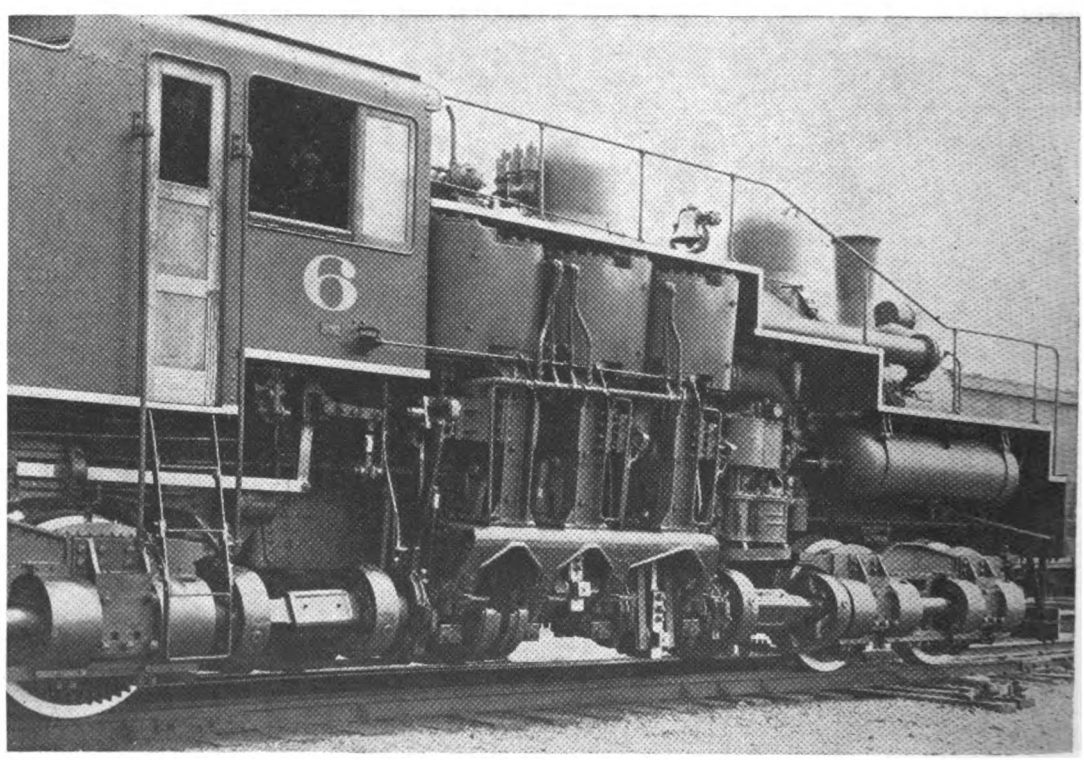
The cab is the vestibule type, of riveted construction. The cab and the coal space, having a capacity of nine tons, are built as a unit and are 6 ft. 10¼ in. long. There is approximately 5½ ft. between the firedoor and coal gates. The cab width is 119 in.

Lubrication is effected by means of two Manzel oil pumps, one a three-feed unit for the engine steam chests and the other a 10-feed unit for the engine guides and bearings. A Nathan four-feed, four-pint automatic sight-feed oiler is located in the cab.

The locomotive is equipped with Westinghouse Schedule ET-6 air brakes having a single 8½-in. cross compound compressor and one 24½-in. by 102-in. main reservoir located under the runboards on the right side.

The tender tank is mounted on a structural frame having sills 12 in. deep. The rectangular tank is 17 ft. 0⅜ in. long, 60 in. deep and 125½ in. wide; it has a capacity of 6,000 gal. The tank is built with 3/16-in. side sheets and ¼-in. bottom sheets.

The tender is supported on a single four-wheel truck and stability is maintained by a hinge connection between engine and tender consisting of a double jaw casting on the rear of the engine frame into which a rigid bar, riveted to the tender frame, and a conventional drawbar are inserted. A drawbar pin in the engine frame casting passes through both bars. The inner surface contours of both the male bar casting and the engine frame casting are such as to allow for considerable movement between engine and tender on vertical curves.



The engine and drive shaft are on the right side of the locomotive

M.B.M.A. Studies

Water Treatment Benefits*

Operating and maintenance savings resulting from water treatment and improvements that can be made to better locomotive boiler performance

THE crucible of war puts the ultimate test to the peacetime practices of all essential industries. During the years of peace we go through a period of experimentation and development. Then when war comes, we are able to get the final evaluation of this work because only the soundest and most productive operations survive such a test.

Water treatment on our railroads has met this test and passed with highest honors. A very large measure of credit has been given to water treatment for a major contribution to the successful operation of our railroads during the recent critical period, handicapped as we have been with a limited inventory of motive power and with a marked shortage of skilled maintenance personnel.

In making our daily inspections and doing everything in our power to keep our boilers operating without undue delays for maintenance, washing, or other causes, we are the first to see the benefits of water treatment. Old timers know the difficulties experienced with bad water which taxed ingenuity to the utmost in spite of a tremendous amount of hard work expended to keep boilers operating in those early days. Our association has reported on the results of water treatment from year to year since its inception and we feel it fitting and proper to continue to do so as we are in a particularly advantageous position to assess its value, since our work is in the front line of locomotive maintenance.

Water treatment has played such an important part in the success of our operations during the war that it deserves full publicity at this time in order to encourage expansion of the program to include all untreated water supplies and to insure full utilization of existing facilities and modernization of inadequate facilities to meet present requirements.

The simplest approach to an understanding of what water treatment does would be to determine its effect on one locomotive and then to multiply the result by the number of steam locomotives in service. Basically, water treatment accomplishes the following things for each locomotive: (1) Prevents scale and corrosion on water-heating surfaces; (2) permits 30-day operation for each washout, thus increasing availability; (3) maintains high thermal efficiency, thus saving fuel; (4) reduces maintenance, thus saving skilled labor and critical materials, and (5) controls steam quality.

This oversimplified form of procedure would establish savings that are truly remarkable, but actually it would not do justice to the subject as the introduction of water treatment brought about fundamental changes in railway operation which have in a large measure been responsible for making possible the high utilization of locomotives and, incidentally, made it possible for railroads to use the high-power steam locomotive itself.

During the first world war railroads generally operated their locomotives over one division only, or about 100 miles. For many years freight locomotives made an average of 3,200 miles per month and passenger engines 4,000 miles per month; shopping for flues was common practice at from 45,000 to 65,000 miles in average water territory and in bad-water territory the mileage was much lower. Without water treatment even these repairs did not eliminate trouble as flues would leak almost every trip and it would often require a boiler maker and helper six to eight hours to caulk.

It is a matter of simple calculation to prove that if such conditions had existed during World War II and if the work produced per month per locomotive had been the same as in the first world war we would have needed over 80,000 locomotives, an increase of some 40,000 units over our actual inventory. Had it been necessary to buy this additional power it would have cost several billion dollars, taken several years' time to build, and the manpower that would have been used making these locomotives could not have been used to make battleships, tanks, aircraft, and all the other tools of warfare.

Fortunately, this problem did not exist because of greatly improved operations.

Effect on Locomotive Operation

During the early twenties the idea of greater utilization of locomotives was advanced. Experiments were conducted in extending locomotive runs over more than one district. The principal objection to be overcome was the matter of boiler maintenance. Many boiler makers believed that it was absolutely necessary to either change the water or wash the boilers after each round trip, and this was undoubtedly true under existing conditions. It was found, however, that by introducing correct water treatment, the installation of proper blow-off equipment, and proper supervision of both of these factors, it was entirely feasible to extend locomotive runs almost without limit insofar as the boiler was concerned. Certain adjustments had to be made in grates, ash pans, and terminal facilities where coal was used as fuel, and these developments went forward simultaneously. The net effect was that, by the late 1930's, practically all railroads were successfully operating their power over as many divisions as their physical limitations permitted. Several very important benefits were derived from this one development.

First, each locomotive was able to operate three to five times the mileage per month. Therefore, the railroads could get the maximum use out of their latest and most improved locomotives and were enabled to scrap their oldest and less efficient smaller power.

Second, where one locomotive could do the work of five or more previously used on a certain run, the result was that terminal fuel consumption was dractically reduced. Standby losses due to having a number of units fired up to handle a certain train together with the inevitable protection units held in readiness were indeed

* Paper prepared for 1945 year book of the Master Boiler Makers' Association.

sizeable. These losses were largely eliminated by extended runs.

Third, with increased utilization assured, railroads could well afford to invest a great deal more capital in each new locomotive purchased to get greater power per unit and to utilize the latest developments in economy devices. As a result, locomotives were purchased and put to work, costing five to ten times as much per unit as had been expended heretofore, and these units developed correspondingly greater horsepower, enabling them to move more cars over the railroad at high speed with greatly reduced cost of operation. The railroads rapidly took advantage of this new possibility and new power was purchased which could not have been economically employed prior to the development of the long-run principle.

With every extension in locomotive operation and with every new locomotive purchase, water treatment became more vital and has been handled accordingly. Testing equipment (illustrated) has been developed that

Dearborn water-testing laboratory for terminals

permits ready determination of the condition of the boiler water in each locomotive both on arrival and departure from important terminals, something that had not been considered feasible before but which has become a prime requisite at all important locomotive terminals in recent years. Personnel has been trained to handle this testing and control program and this work has paid big dividends in improved performance and in helping to increase the availability of the power.

A complete water treatment program does the following major things with many subdivisions under each one: (1) Individually treats each water supply to render it non-scale forming and to prevent pitting and corrosion difficulties. The treatments are of such nature as to prevent incrustation of all underground pipe lines and of boiler checks, branch pipes, and locomotive injectors; (2) establishes a schedule of road and terminal blow-down to keep the boiler water in proper condition so as to permit 30-day operation for each washout, and (3) provides proper control facilities and personnel to check the operation of the treating plants and the boilers on a regular schedule. In addition, since full benefits of the water-treatment program cannot be obtained unless every factor in boiler operation is kept in tune with best possible practice, the water-treatment engineer follows the boiler into the enginehouse and interests himself in seeing to it that proper practices are followed in every step from blow-down right on through boiler-washing operations and firing up.

While great advances have been made in improving locomotive boiler performance, much still remains to be accomplished. It is generally considered desirable to operate boilers 30 days for either a water change or a washout. Many roads are getting these benefits, but quite a few fail to do so either through insufficient supervision of blow-down or possibly due to lack of understanding and application on the part of the supervising forces of the benefits that can be obtained through proper attention to this problem. Old-fashioned prejudice is responsible in some cases and should be guarded against by critical self analysis to the end that the best and most efficient operation is obtained in every instance.

An important feature of doing the job less frequently is to do it well when it is done. This requires conscientious washing and supervision at the scheduled washout times and the correct tools and facilities to do the work thoroughly.

Washout openings must be located properly, suitable washout nozzles must be available together with instructions for their use, and adequate water pressure is essential. The boilers must be cooled down prior to washout to minimize stress and at the same time avoid possibility of sludge or mud baking onto exposed hot, dry surfaces of the tubes and sheets. The cool-down method of boiler washing has been reported several times in our proceedings and we recommend it for further consideration.

Water treatment has made a remarkable record of savings during the war years. In 1944, according to the thirty-third annual report of the director of the Bureau of Locomotive Inspection, 1,302 time extensions were granted in the removal of flues which is indicative of the effect of water treatment because these extensions could not have been granted if the flues had not been clean. This represents a continuation of the improved conditions reported in detail in our proceedings of 1941.

Material Savings

Much critical material has been saved for other uses by water treatment. C. R. Knowles, former superintendent of water service of the Illinois Central, retired, in an article on water treatment in the April 24, 1943, issue of the Railway Age stated: "The flues in a typical locomotive containing 119 2¼-in. flues and 30 5½-in. superheater tubes, all 19 ft. 6 in. long, weigh 11,438 lb. In addition, a firebox with 185 sq. ft. of heating surface, constructed of ⅜-in. steel, weighs 2,832 lb., making a total of 14,270 lb. of steel in flues and firebox.

"Sixty such locomotives might reasonably operate in one treated-water district, representing 856,200 lb. of material directly affected by water treatment. Having established that the life of flues and tubes will be increased from 5 to 15 years, there is a saving in this material over a 15-year period of 1,327, 560 lb., or 91,504 lb. per year.

"Doubling the life of fireboxes from 10 to 20 years represents a 20-year saving in material of 169,920 lb., or an annual saving of 8,496 lb. Thus, the combined saving in flues and fireboxes is 100,000 lb. per year for a typical group of locomotives operating on completely treated water.

"The weight of tubes and flues in one of the largest locomotives in service is 32,586 lb., or 1,955,160 lb. for

a group of 60. Trebling the life of flues and tubes will effect an annual saving of 146,344 lb. over a 15-year period. The firebox of this locomotive weighs 19,500 lb., representing 1,170,000 lb. for the 60 locomotives. Doubling the life of fireboxes will save this material every 20 years, or an annual saving over the 20-year period of 53,400 lb. The combined saving each year is 199,744 lb. in flues, tubes and firebox sheets without counting staybolts and the thousands of man-hours of labor made available for other work."

These figures indicate the savings in critical materials and skilled labor that has been effected through the water-treatment program.

According to latest available figures by Railway Engineering and Maintenance Cyclopedia, our locomotives use some 437,000,000,000 gal. of water each year. It is estimated that 44 per cent of this water, or some 200,000,000,000 gal., is being treated in full or in part, thus removing or making harmless more than 220,000,000 lb. of scale annually, saving about $29,000,000 per year on the basis of 13 cents per pound of scale. The same source states that treatment is being used at 5,000 water stations and that there are 8,250 additional stations at which water treatment could be used with economy to our roads.

We feel that the savings usually reported at the old 1924 A.R.E.A. figure are entirely too low and that if this figure were to be brought up to date, it would be helpful in expediting the completion of the water-treatment program. The present 13-cent figure gives ample savings in most instances to justify treating-plant installations, but it is so far below the true savings it may well be that sufficient urgency is not presented to management to place the proper emphasis on this work.

Based on published index figures by the A.A.R., the 13-cent-per-pound savings could be increased as follows. Using the cost in May, 1933, as the basis or 100, the cost of fuel in December, 1944, was 185.1 and other material and supplies 162.4. Using 1918 labor cost as 100, 1942 labor cost is given as 185.

A rough calculation would indicate a minimum weighted increase of 75 per cent in the costs that enter into the A.R.E.A. formulae, which, on this basis, would justify a minimum saving of $1.75 \times 13 = 22.75$ cents per pound of scale-forming materials neutralized in our water supplies today. Use of this figure in calculating savings should be of great help in compelling attention to the truly wonderful savings to be realized by treating all remaining raw water supplies.

The really clean boilers made possible by water treatment have opened the way for the railroads to realize the economy of higher pressure design which would have been impossible without scale elimination through treated water. The fact that high-pressure boilers are more susceptible to maintenance occasioned by poor water has emphasized the necessity of strict control over the existing water treatment and all boilers have benefitted accordingly.

There should be a word of caution, however, against allowing the theoretical design of high-pressure boilers to ignore the practical aspects of railroad operation. New designs should allow adequate steam space, provide for complete water circulation without steam or mud pockets, and have facilities for really effective blow-down. Finally, the question of easy and complete washing must not be overlooked. In the matter of general boiler construction, the intercrystalline corrosion studies carried out in both public and private laboratories with the cooperation of the railroads for the purpose of creating better water treatment have pointed the way to better locomotive boiler structures. It has been shown that overstressing of seams through poor fittings or careless workmanship is a basic factor in the cracking of rivets and sheets which has been blamed on the intercrystalline corrosion tendencies of certain untreated or improperly treated waters. The importance of keeping seams tight to avoid future heavy repairs has also been brought to light and the great advantage of the all-welded boiler over the riveted boiler has been emphasized. We anticipate further developments along this line with the use of a good many welded boilers in the near future.

Attention has been focused on developments in better steel for boiler purposes and new alloys are under intensive study by a western railroad whose research laboratory has taken a broad interest in water treatment.

A recent ramification showing the importance of the treatment of railroad water supplies has developed in the maintenance of engine-cooling systems and passenger train steam-heat generators on Diesel power. Contrary to the original belief that Diesel power could ignore the quality of its water supplies, the intricacy of these machines and the flash-boiler type of steam generators carried in their restricted space has developed water troubles requiring even greater care than the steam locomotive. Water treatment has risen to the demand where established types of treatment have been inadequate and new special treatments have been devised, even to the extent of providing demineralized water with new types of synthetic zeolites and a following treatment to avoid corrosion.

Nalco laboratory for terminal water testing

Advantages Summarized

In summarizing, we can unequivocally state that the water-treatment program has done the following things for our railroads: (1) Made possible long runs of steam locomotives; (2) permitted use of high-power locomotives; (3) reduced fuel consumption (steam locomotive use has improved by over 50,000,000 tons per year based on work performed according to A.A.R. figures); (4) saved the railroads not less than $30,000,000 annually; (5) during each war year saved a substantial tonnage of steel; (6) contributed very largely to the high avail-

(*Continued on page 579*)

Fuel Records and Statistics

A review of 1945 revisions in I. C. C. Form OS reports by the Railway Fuel and Traveling Engineers' Association Committee on Fuel Records and Statistics—Other shortcomings are pointed out in a report for the Association's 1945 year book

THE report of your committee for the year 1940 covered in some detail certain features of Form OS reports to the Interstate Commerce Commission and the year 1941 report continued this discussion. The 1941 report dealt specifically with Coal Equivalents and the various methods of procedure for their determination, recommending certain limiting conditions. These limitations were tabulated and a comparison made with the practices of 30 Class I railroads in making their reports to the Commission. In 1941 a committee was appointed to "take appropriate action to determine the possibility of obtaining the publication of more detailed fuel statistical reports for Class I railways than have been made available for general distribution." A progress report of this committee was submitted to the full membership of the Railway Fuel and Traveling Engineers' Association. As a result of the work of this committee and excellent cooperation on the part of the A.A.R. Accounting Division Committee on Statistics, certain additions were made on Forms OS-A, OS-B and OS-E, effective January 1, 1945. The following is a tabulation of these additions.

Additions to Form OS-A—Freight-Train Performance

2—TRAIN MILES:
- 2-01—Steam locomotive propelled trains
- 2-02—Diesel-electric locomotive propelled trains
- 2-03—Electric locomotive propelled trains
- 2-04—Other locomotive propelled trains
- 2-05—Total locomotive propelled trains

3—ROAD LOCOMOTIVE-MILES:
- 3-06—Total, Diesel-electric only

Train-switching:
- 3-10—Diesel-electric locomotives
- 3-14—Miles at initial and final terminals included in total (item 3-13)

5—GROSS TON-MILES OF ROAD LOCOMOTIVES AND TENDERS (THOUSANDS):
- 5-03—Diesel-electric locomotives

6—GROSS TON-MILES OF CARS, CONTENTS, AND CABOOSES (THOUSANDS):
- 6-03—Total in Diesel-electric locomotive trains

8—TRAIN-HOURS (INCLUDING TRAIN-SWITCHING HOURS AT WAY STATIONS):
- 8-01—Steam-locomotive-propelled trains
- 8-02—Diesel-electric-locomotive-propelled trains
- 8-03—Electric-locomotive-propelled trains
- 8-04—Other-locomotive-propelled trains
- 8-05—Motor-car-propelled trains

Additions to Form OS-B—Passenger-Train Performance

2—TRAIN-MILES:
- 2-01—Steam-locomotive-propelled trains
- 2-02—Diesel-electric-locomotive-propelled trains
- 2-03—Electric-locomotive-propelled trains
- 2-04—Other-locomotive-propelled trains

3—ROAD MOTIVE-POWER MILES:

Locomotive-miles:
- 3-06—Total, Diesel-electric only
- 3-08—Total, other (Diesel and gasoline motor and gasoline electric)
- 3-10—Train switching miles, Diesel-electric locomotives only
- 3-12—Train switching miles, other locomotives

5—TRAIN-HOURS:
- 5-01—Steam-locomotive-propelled trains
- 5-02—Diesel-electric-locomotive-propelled trains
- 5-03—Electric-locomotive-propelled trains
- 5-04—Other-locomotive-propelled trains

Additions to Form OS-E—Fuel and Power for Locomotives and Rail-Motor Cars

2—QUANTITIES OF FUEL AND POWER CHARGED TO YARD AND TRAIN ACCOUNTS:

Quantities consumed in road freight service (Accounts 394, 395 and 396):
- 2-10—Diesel fuel (gallons)
- 2-12—Gasoline (gallons)

Quantities consumed in road passenger service (Accounts 394, 395 and 396):
- 2-22—Total fuel by motor-car trains (equated net tons coal equivalent)

8—FUEL AND POWER CONSUMED PER 1,000 GROSS TON-MILES (INCLUDING LOCOMOTIVES AND TENDERS)—ROAD FREIGHT SERVICE:
- 8-03—Gallons of Diesel fuel (Diesel locomotives) (2-01 ÷ [5-03 0S-A + 6-03 0S-A])

9—FUEL AND POWER CONSUMED PER PASSENGER-TRAIN CAR-MILE—ROAD PASSENGER SERVICE:
- 9-05—Equated pounds of fuel (motor-car trains) (2-22 × 2,000 ÷ 4-21 0S-B)

The additions to Forms OS-A and OS-B listed make possible the compilation of statistics for the differently propelled trains of such items as:

X1—Passenger car-miles per passenger train-mile; i. e., average cars per train
X2—Gross ton-miles per freight train-mile; i. e., average gross tons per train
X3—Gross ton-miles per freight train-hour; i. e., average ton-miles per hour
X4—Freight train-miles per freight train-hour; i. e., average speed in m.p.h.

All of these are extremely useful in the analysis of the relative efficiency of the differently propelled trains.

Neither Form OS-A nor Form OS-B segregates the locomotive-miles (Principal and Helper) according to the differently propelled trains. For this reason the following equally important items cannot be computed:

X5—Locomotive miles (principal and helper)
X6—Gross ton-miles (excluding the locomotives and tenders) per locomotive-mile; i. e., the average gross tons per locomotive.

While items X1 to X4 can be computed from the

information now shown on Forms OS-A and OS-B, there is no provision made on either form to show this information.

As to Form OS-E, the quantities of fuel and power, item 2 (2-01 to 2-24 both inclusive) are not so segregated as to permit of computing under averages (items 7, 8 and 9) according to the differently propelled trains. In this connection, even with the additions to Forms OS-A, OS-B and OS-E, the usefulness of Form OS-E is largely restricted for the following reasons:

On Form OS-A, Gross Ton-Miles (items 5-01, 5-02, 5-03, 5-04 and 5-05) and on Form OS-B, Passenger Train Car-Miles (items 4-09, 4-10, 4-11, 4-12 and 4-13) are segregated as between *trains* of different propulsion, according to the kind of fuel used by the principal locomotive, but on Form OS-E (Fuel and Power for Locomotives) the fuel is separated by locomotives only and, therefore, it makes no provision for trains that are rather common at present; i. e., where "Diesel trains" have steam locomotives assisting or doubleheading. This, of course, results in distorted figures in the averages on Form OS-E (items 8-03 and 9-03, for example).

Notwithstanding the separations made on Forms OS-A and OS-B for items of Passenger-Train Car-Miles and Gross Ton-Miles, as between *Diesel-propelled* (principal locomotive) and Steam-propelled (principal locomotive), there is no provision made on Form OS-E to set the fuel up in the same manner, so that the road and helper fuel will follow the ton-miles, or car-miles derived from the consumption of this combined road and helper fuel.

The progressive increase in the number of Diesel locomotives on some roads in the United States emphasies the importances of statistics that will convey a picture of the relative fuel performance of the Diesel-propelled trains as compared with trains using fuel other than Diesel oil. Steam helpers are common on Diesel-propelled trains. It is evident, therefore, that a tabulation of the helper fuel by *kinds of trains* is necessary to produce fuel service units that will be comparable. It is strongly recommended that consideration be given to the revision of Form OS-E to provide for setting up the helper coal figures by *kinds of trains* so that comparable figures will be available as between railroads.

On the Baltimore & Ohio, in July, 1945, 31 per cent of the passenger-train car miles were produced by Diesel-propelled trains. Of the fuel used by Diesel-propelled trains 9.7 per cent was used by steam helpers. In freight service, of the total gross ton-miles, 2.7 per cent was produced by Diesel-propelled trains and, of the fuel used by Diesel-propelled trains, 11.3 per cent was used by steam helpers. While there were no helpers in yard service, it is interesting to note that at the four terminals that use Diesel locomotives 97.6 per cent of the yard-engine hours was produced by Diesel switchers. This figure, however, represents but 16.6 per cent of the yard engine hours produced on the B. &. O.

The committee members are E. E. Ramey (chairman), superintendent fuel conservation, B. & O.; P. E. Buettell, fuel supervisor, C. M. St. P. & P.; J. G. Crawford, fuel engineer, C. B. & Q.; J. R. Jackson, engineer of tests, Mo. Pac.; H. Morris, superintendent fuel and locomotive performance, C. of N. J.; E. G. Sanders, fuel conservation engineer, A. T. & S. F.; W. R. Sugg, general supervisor air brakes, Mo. Pac.; W. J. Tapp, superintendent fuel conservation, D. & R. G. W.; R. J. Tucker, assistant to fuel supervisor, C. & O.

Water Treatment Benefits

(*Continued from page 577*)

ability of steam locomotives which made it possible for about 42,000 locomotives to deliver nearly twice the work done by some 64,000 locomotives in World War I; (7) reduced shopping time of locomotives to the minimum required by machinery repairs, and (8) contributed to a performance record where boiler failures are virtually eliminated.

The record of water treatment on our railroads is one of great service. Vigilance needs to be exercised by everyone to maintain the facilities and continue to obtain the benefits of this program. Rapid extension of water treatment to all sizeable supplies is indicated and larger tenders and alteration of schedules should permit elimination of small stations which would not otherwise warrant treatment installations.

The committee consists of John P. Powers (chairman), system boiler inspector, C. & N. W.; H. L. Harrell (vice-chairman), shop engineer, I.C.; F. A. Longo, general boiler inspector, Sou. Pac.; B. C. King, general boiler inspector, Nor. Pac.; H. C. Haviland, supervisor of boilers, N. Y. C.; I. N. Moseley, master boiler maker, N. & W., and E. H. Gilley, general boiler foreman, Grand Trunk.

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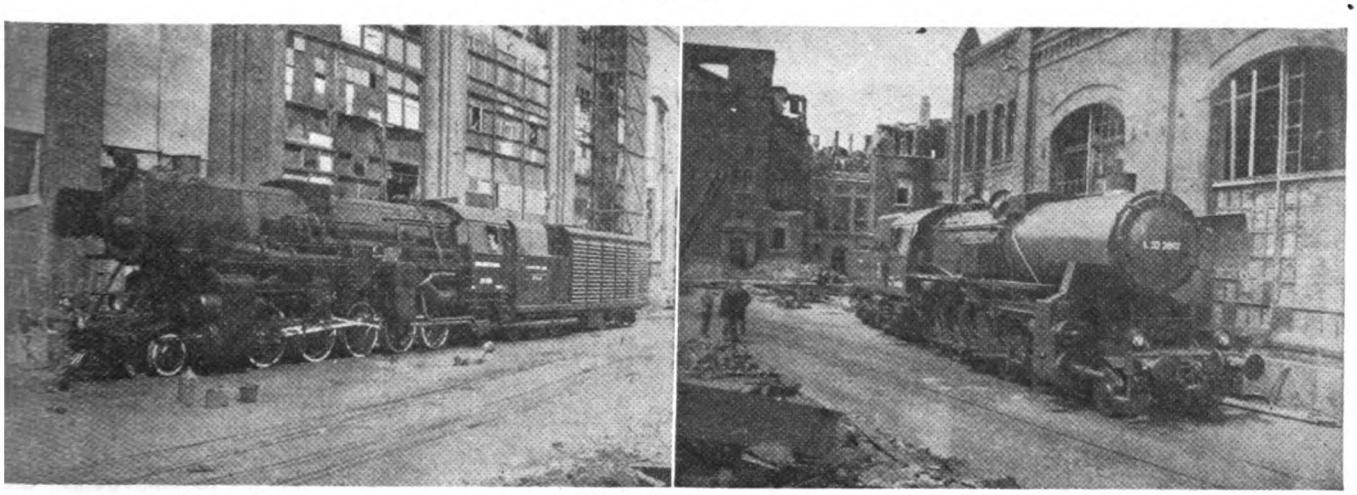


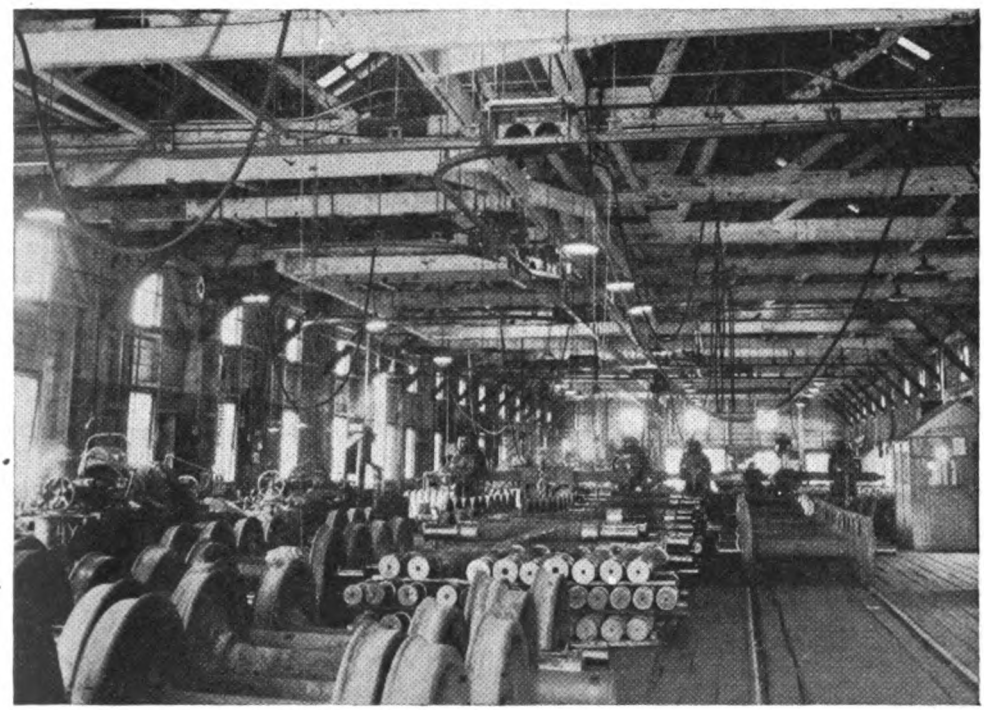
German locomotives repaired by the M. R. S. for use on German railways—At the left is a modern condensing-type locomotive, and at the right, a war-time non-condensing type—The photographs were received from Lt. E. D. Shain, a Reading employee then with the 757th railway shop battalion

Improving Car Shop Facilities*

Material handling an important subject for study —Fabrication and reclamation by welding of increasing interest — Best wheel shop practices must be initiated at all points

For many years the development of improved car shop facilities has been a live subject on the Delaware & Hudson. A number of years ago competitive car building contests were held annually at our freight-car repair shops. This novel plan of education was conceived to disclose the advantages that come from the use of efficient shop facilities and practices. While the contests aided in the development of the use of improved tools and methods, the important lesson we learned was the value of getting our material to a car and arranging it to effect maximum output with minimum effort, eliminating the loss of applied man hours.

Before the war, the thought had been pretty well-established that it would be necessary to eliminate some antiquated practices. Demands upon our limited shop capacity far beyond anything previously experienced came with the war. We were confronted with an acute manpower shortage and restrictions on the supply of essential materials at a time when the demands were greatest. Probably at no time in our experience were management and supervision so pressed for the development of new ideas to cope with a situation. Now that the war has ended we can all look back at the record and feel, with satisfaction, that we met the situation squarely and did a good job despite the handicaps, and out of it we have gained a knowledge that will prove invaluable with the passing of time.



The Oneonta wheel shop of the Delaware & Hudson

One of the problems that faced us, with the limited manpower available, was the handling and delivering of material in and about shops and repair tracks. New methods and practices were developed to insure that such operations could be handled with minimum delay. The problem was solved by expanding the use of mechanical devices and providing roadways over which tractors, cranes, trailers, etc., could travel to best advantage. The installation of good concrete runways took us out of the mud and put the operation of these vehicles on a firm footing. The handling of material by such modern means is no more efficient than the ground upon which it operates. Getting material from the source of supply to the car undergoing repairs is of prime importance in effecting maximum output with minimum applied man-hours.

Our first problem was to procure the equipment needed and then organize scheduled deliveries to avoid duplication of effort and idle time. Fortunately, we have been gradually adding mechanical equipment to that on hand and today we find ourselves in a rather favorable position in that we have various types of mobile units adaptable for handling material with the least human effort.

At a series of discussion group meetings attended by our supervisors, many of our problems were analyzed and suggestions offered. Some of the suggestions were adopted and proved very valuable in improving the efficiency of our shop operation. We have found that material-handling equipment can best be utilized when under the supervision of one foreman, that is, by central-

* A paper delivered before the Eastern Car Foreman's Association at New York on October 12, 1945.

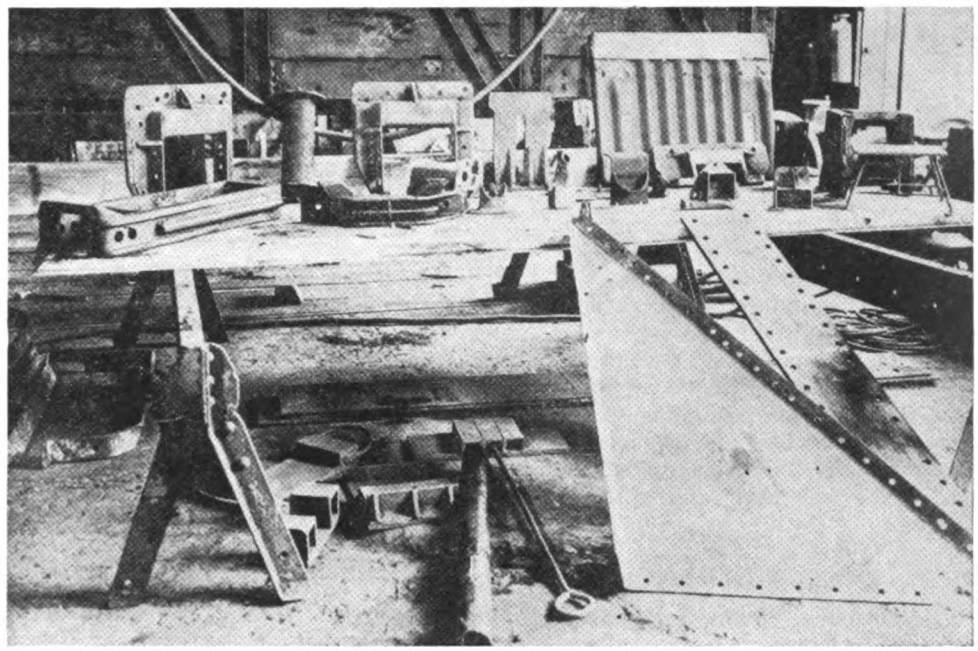
ized control. A central station established as headquarters for the material supervisor, where all other foremen can make known their requirements and from which the operation of the various machines can be scheduled, gives excellent results. Empty trips can be eliminated, duplicate trips avoided and maximum loading of machines can be secured.

Material supply and handling represents, to a large extent, the supporting labor, the labor that is required as a preliminary operation before the repair or construction is actually started, and to keep it going after it is started. If our supporting labor is not efficient, our shop operation is not efficient.

Establishing a good system is not a case merely of obtaining the equipment, furnishing good roads, good operators and supervision. Constant study and development of facts are needed whereby improvements can be made, and changing conditions recognized and corrected. This can be handled only through direct contact between the plant management, the supervision and the workmen. It requires a supervisory training program or discussion group. A discussion group was established at the Oneonta car shop and each supervisor made suggestions and recommendations that would improve the service. As a result of this a smooth-operating, efficient handling and delivery service has been established. The manual effort required in handling material has been considerably reduced and efficiency increased. This causes the heavy burden to be lifted from the shoulders of the employee and placed on the mechanical devices, where it belongs, thereby making available the service of a lot of good men to perform the actual mechanical work on the cars. The employee who has for years pushed a two-wheel wagon around the shop with heavy loads is the man who will tell you that tractors, trailers and Chore Boys have made this job easier and that, in itself, speaks for the success of this undertaking.

Servicing Material-Handling Equipment

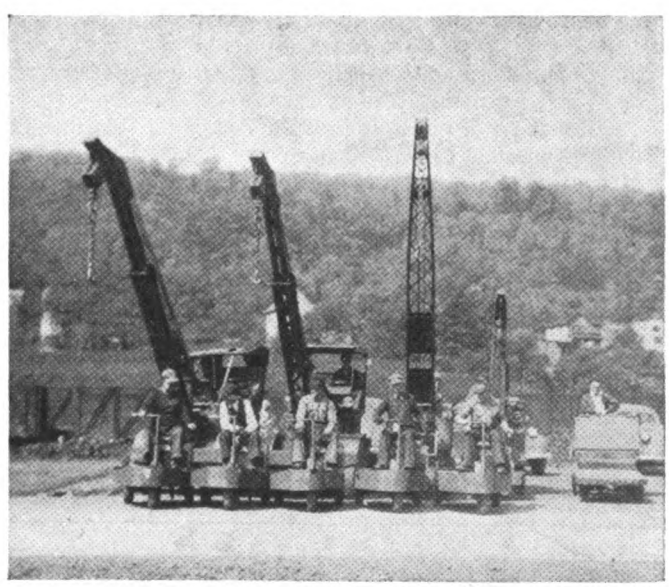
Many thousands of dollars worth of mechanical-handling equipment creates a problem of proper maintenance and it is necessary to schedule the inspection, servicing and repairs to this equipment to avoid the possibility of the equipment becoming badly damaged from neglect and kept out of service. A tractor, Chore Boy or crane out of service due to neglect of lack of maintenance will reduce materially the value of a coordinated material-handling program. Periodical inspection reports, which in some cases are daily and in others weekly, not only serve to indicate that machines are being properly maintained but they provide a good record of the durability and the adaptability of the various machines to their jobs and make it possible to observe any of the weak points where, perhaps, there is a need for modernization.



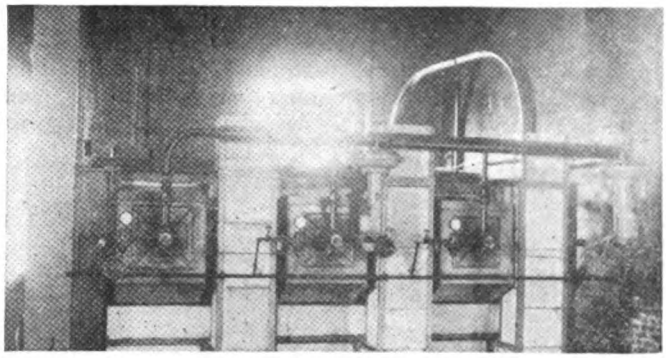
Some of the parts made or reclaimed by welding on the D. & H. during the war

Shop Supervisors Meet

Confronted as we were with the difficulties of shop operation during the war, management soon realized the value of the exchange of ideas among supervisors and the submission of suggestions and their development if they had merit. Meetings, held weekly or more often, gave each supervisor an opportunity to make known his problems and practices were developed which proved valuable during the war and will prove more valuable in the years



Some of the material-handling equipment at the Delaware & Hudson's Oneonta car shop



Temperature-regulated car-bottom furnaces are needed for proper reclamation work

to come. Two things have been accomplished, supervisors realize the value of thinking and planning, and understand each other better; and, the problems of the supervisors are brought to the attention of the management and a better understanding of procedure is obtained. The search for new methods and the development of new procedures is something that must not fall by the wayside. We will need them in the future more than ever before.

Reclamation Work

Because of economic conditions in the years before the war the reclamation of material was given very thorough study on all railroads. Methods and practices were developed to save money and the reclamation of material was a well-established practice. The reclamation of couplers, truck side frames, knuckles, knuckle locks, brake beams and many other car parts had been developed to a point where we thought we could proceed no further. We were fortunate in having this basic experience in reclamation to use and improve upon during the war years when we were confronted with the material shortage. All of us who thought we were doing a great job prior to the war can now say that we had only started. Welding methods were improved upon. Parts made from open-hearth plate and angles, fabricated, assembled on jigs and welded, were substituted for unobtainable castings. These included such parts as strikers, coupler carrier irons, draft stops, center-sill fillers and other small castings. The A.A.R. restrictions that existed on the reclamation of material were relaxed and we have learned many things about welding that we never dreamed of before. The value of this knowledge will be carried into the post-war years and result in great savings.

Installation of annealing and normalizing furnaces has made it possible to restore car parts to service with confidence that they will stand up. Furnaces regulated and controlled automatically eliminate a large part of the human element from such operations. The installation of such a furnace has been made at our main car shop with the result that the scope of our activities in reclamation has been greatly increased. The increased capacity makes it possible to normalize all truck side frames removed from cars going through the shop thereby affording better inspection and a guarantee of better service.

Straightening Stall

We have been confronted with increased damage to open-top equipment by loading and unloading machines and from other accidents. This damage is so extensive that numerous cars are rendered unfit for further service until they are repaired. Many man-hours are required to remove damaged parts from cars, straighten them and replace them. This led to the development of a straightening stall on our railroad with which you are probably now familiar through the publication of its description in the *Railway Mechanical Engineer*.* Such a straightening stall involving the use of air jacks, upright posts set in concrete, overhead hoists and runways and cross beams on which to jack, has made it possible to take some extreme cases of damaged cars and straighten them without so much as removing a rivet. Man-hour requirements are reduced to a figure that is amazing. This provides the man-hours saved to build and repair other equipment. The elimination of the cost of material and return of the car to service in a much shorter time is valuable. A car with bent sides, ends and perhaps a twisted underframe often can be repaired and returned to service within eight hours. The movement and adjusting of loads that have shifted can be accomplished in such a facility as this with one or two men, thereby avoiding load transfers or expensive hand jacking. Bent center sills that were formerly heated and straightened through the use of pulling jacks, sledges, and other methods involving considerable hard work can now be jacked back into place cold in a very short length of time. Without a doubt the straightening stall has created a method of restoring cars

TRACTOR INSPECTION REPORT

Date _____

	Plat.Elec. ET-1	Gas-Elec. ET-6	Loadmaster ET-9	Krane Kar ET-15	Krane Kar ET-16	Yale Lift ET-20
Inspected by						
Oil Changed						
Lubricated						
Tires						
Brakes						
Kind of Oil						
Battery Filled with Water						
Battery Cleaned						
Battery Insp. by Electrician						
Date Filled with Castor Oil						
Steering Mechanism						
Hoisting Mech., Cables & Hooks						
Repairs to be Made						
Repairs Made						
Remarks						
Operator's Signature						

Regular attention for material-handling equipment keeps it in best condition for service

to service within a period of time that was heretofore unthought of. Like the tractor and trailer system of delivering material, a system of repairing cars in the straightening stall has no end as to the extent to which it can be developed. The ingenuity used by workmen to save backbreaking work has no limit. The stalls are particularly adaptable to outside points and gateways and, on our railroad, each main gateway is so equipped. We have found it has been possible to reduce transfers, car delays, lading delays and backbreaking work from those small points which, at the best, are usually equipped only for light repairs.

* See *Railway Mechanical Engineer*, February, 1945, p. 75.

Wheel-Shop Practices

With the cooperation of the railroad management, the Association of American Railroads and wheel manufacturers, wheel shop practices have been improved. The A.A.R. mechanical inspections have brought home, directly to the wheel-shop foreman and the machine operators, the necessity for more accurate and painstaking machining of car axles and wheels. The Wheel Manual has illustrated very vividly what is required and, in addition, has told why it was required. The mechanical inspectors that visited the various wheel shops were men

CHORE BOY INSPECTION REPORT

Date _____

	Chore Boy ET-18	Chore Boy ET-19	Chore Boy ET-21	Chore Boy ET-22	Chore Boy ET-23
Inspected by					
Oil Changed					
Lubricated					
Tires					
Brakes					
Kind of Oil					
Steering Mechanism					
Repairs to be Made					
Repairs Made					
Remarks					
Operator's Signature					

Chore Boys are inspected and serviced at scheduled intervals

of experience who could talk shop language in such a way that full benefit was obtained in educating the employee.

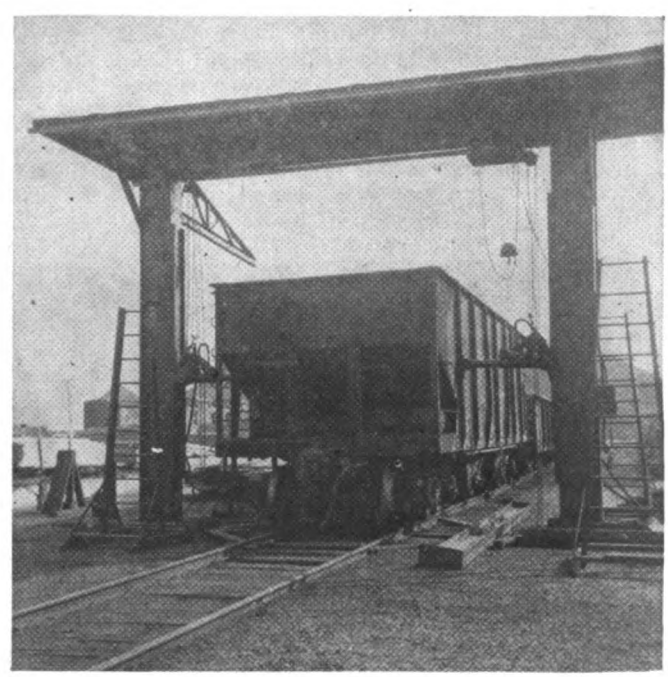
Probably a large percentage of hot-box troubles can be traced, directly or indirectly, to poor wheel-shop practice. The methods now established for a periodical checking of all wheel-shop machinery is one of the great steps that has been taken to insure proper wheel-shop work.

For years we have trued journals that have been overheated excessively. Visual inspection was about all that the journals received to discover cracks. Dependence was placed largely upon the operator of the journal lathe to discover such defects while taking the cut. The use of Magnaflux testing through which such defects as seamed journals and wheel seats are found has made it possible to remove dangerous axles from service which otherwise might have been used and have caused a serious accident. With a system properly organized, supervised and carried out, there is little danger now for a bad axle getting out into service. The use of the recording gauges and the keeping of other records is bound to reduce failures. The wheel shop foreman and his employees realize that they carry the responsibility for the satisfactory performance of each pair of wheels produced while it is in service. On our railroad, wheel-shop work is concentrated at one major point thereby making it possible to give better general supervision to the work and eliminate divided responsibility.

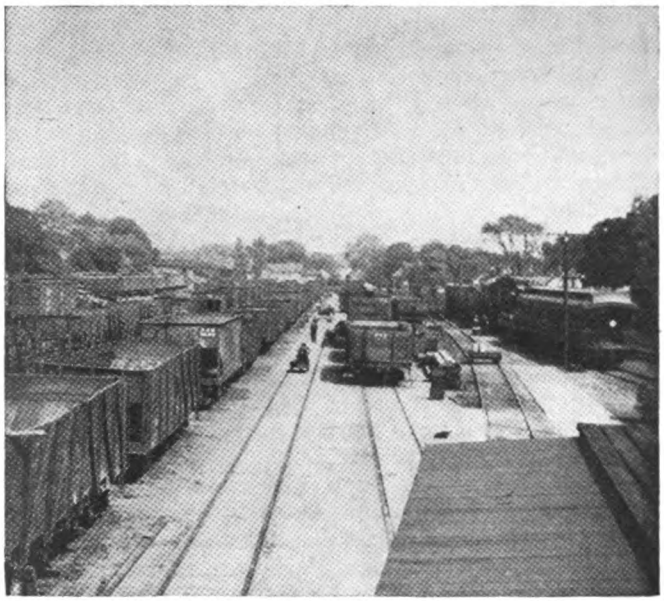
No wheel shop, regardless of its efforts to carry out the practices outlined in the A.A.R. Manual, can function without proper machinery. A shop faced with the obsolescence of machines and machines that are not properly maintained cannot do good work. With the need of better wheel work it has been necessary to give full consideration to the scrapping of obsolete machinery or worn-out machinery, and install modern, up-to-date machinery that will do the work required. This we have done in our shop. Deferred maintenance on wheel-shop machinery will be reflected in the hot-box record in a manner similar to which laxity in accident prevention work will reflect in your accident record.

Good wheel-shop practice does not end at the wheel shop. Regardless of how much care is taken to produce good work in the wheel shop it can be quickly destroyed by improper handling of the wheels after they leave the wheel shop. Damage to journals during loading processes must be given very close attention to avoid nicked journals. Several years ago, we developed a wheel car having saddles to accommodate the wheels in such a manner that they could not possibly shift, thereby eliminating flange and journal contact enroute. This type of wheel car has proved very successful. They will accommodate either a single-, double- or triple-deck wheel load, or from 18 to 38 pairs of wheels on the one car. The use of individual blocking for each pair of wheels is eliminated with this type of car thereby saving a large amount of labor and material. Its use also practically eliminates the need for renewal of car floors that soon wear out with the use of spiked blocks. It is likewise important to see that old wheels being shipped in are properly handled when loaded at the outside points to prevent unnecessary damage to the journals and eliminate unnecessary wheel-shop work.

With more rigid rules and restrictions placed on wheel-shop practices, it is only natural for supervision to assume the attitude that work output will decrease. Therefore, devices for checking the boring mills, axle lathes and other equipment have to be provided, master gauges furnished and considerable research done on the part of the foreman and the employees to establish methods whereby accurate work can be accomplished as quickly as inaccurate work. We have found it takes a lot of time spent in the education of employees, encouragement and



A straightening stall for damaged open-top cars



Concrete runways along repair tracks at Oneonta allow best use of material-handling equipment

perseverance, to get them to think the new way is better than the old and to develop methods to accomplish it.

The hot-box situation is more or less tied in with good shop practice. Rule 66, in itself, is a shop practice. The current A.A.R. monthly reports indicate that on practically every railroad the number of hot boxes is constantly increasing. We are research people in this respect, ever trying to lay our finger on the causes. The quality of car oils is, in our opinion, something that requires more direct consideration both from a new oil standpoint as well as proper reclamation. Better car oil is needed. Reclamation facilities require constant attention so that a standard is maintained that will meet the A.A.R. specification. Oil and waste reclamation processes are pretty well established; however, we will have to be on the alert to recognize improved facilities as the oil improves in quality so that the proper relation can be maintained between new and reclaimed oil.

Facilities for the proper maintenance of various types of brake-beam supports will have to receive some consideration in the near future. There are a large number of various kinds of brake-beam supports involving angles, springs, brackets, pins, bolts, rivets, etc. I believe the number of brake-beam supports that are found missing on cars in service indicate the need of better facilities in our shops and on our repair tracks to maintain them.

For a number of years we have had a modern brake-beam reclamation plant at the Oneonta, N. Y., shop. The plant is equipped with machinery of the type that makes it possible for one man to do all the reclamation work with a normal production of approximately 5,000 brake beams per year. Test machines are used so we are sure of obtaining a brake beam that is equally as good as and meets the test required of new beams.

The application of AB brakes to all cars by January 1, 1949, is a problem in itself. The manner of application, piping and anchorage to the car, must be proper to avoid expensive maintenance of the brakes after they are applied. Proper pipe bends, good threads and alignment of pipes must be made on the first application to prevent future failures. This application is truly a mechanical job and needs close supervision. Special pipe benders and threading machines can be provided to insure good workmanship.

The centralization at Oneonta shops of all wheel-shop work, brake-beam reclamation, journal-box packing reclamation, air-brake valve repairs, wood mill work, heavy freight car repairs, dismantling programs, material reclamation, blacksmith-shop work, jack and pneumatic-tool repairs, baggage-truck, freight-house-truck and material-handling-equipment maintenance has made it possible to develop and supervise these operations with a minimum expenditure for tools and manpower.

Our present supervisors with all their background of experience may find themselves unable to keep up-to-date. Some of the older men who have been through the mill will have to provide the impetus to the younger men, and the younger men with qualifications for study, observation and job interest, together with their opportunity for better education, are the men we must develop and depend upon for the future. The development of thoughtful interest in their jobs among supervisors and workmen has definitely become a "shop facility."

On our railroad, the Car Department Supervisors' Association plays an active part in developing ideas and provides a medium through which supervisors have an opportunity to discuss the A.A.R. rules, working agreements and their general problems. Meetings are held on each division once a month with the divisional car foreman acting as chairman. Through this medium it is possible to promote education and round-the-table discussions. The outside-point foremen and the shop foremen are afforded the opportunity to become better acquainted with each others' problems. The superintendent of car equipment, and members of his staff attend these meetings. The subject of car design is discussed and ideas exchanged on new developments and methods.

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The Chicago & North Western's "400" leaving Chicago for the Twin Cities

Colloidal Fuel*

By D. W. Machin†

Early development reviewed— Recent mid-western experiments and trials — Economics of fuel in Kansas City area

IN 1938 a casual interest in the general subject of colloidal fuel accounted for the establishment of a modest research program to be carried on at the Kansas State College at Manhattan, Kan., in co-operation with the Kansas Industrial Research Commission. As the general fuel situation became more critical in the latter part of 1942, this research work was intensified. An exhaustive study of the available literature was reviewed, the patent situation studied, laboratory experimentation was intensified, burning tests were conducted, a pilot plant for the production of colloidal fuel was constructed and operated and definite, encouraging results were obtained.

During the spring of 1943, large-scale intermittent and continuous burning tests were conducted which definitely proved that colloidal fuel (approximately 40 per cent coal and 60 per cent oil by weight) can be prepared from southwestern coal and mid-continent oil. This fuel can be satisfactorily burned in standard commercial or industrial burning equipment without appreciable alteration in a completely satisfactory manner and with an efficiency somewhat higher than oil and lower than coal. Upon completion of the research and development work and large-scale burning tests, the economics of the problem were carefully studied, a plant designed and laid out and estimates prepared. This study indicated that in the Kansas City consuming area colloidal fuel is not as economical as coal or oil when the fuels are compared on the basis of cost per million B.t.u.

This particular situation prevails in the Kansas City area because in that market both coal and oil are cheap commodities. The cost of processing colloidal fuel must be added to the cost of the ingredients, thereby increasing the final cost when measured in terms of heat units. This same condition, however, might not hold true in a consuming area further removed from the source of oil and coal and it is estimated that there are large consuming areas in the United States where colloidal fuel would be cheaper than oil. This is particularly true at points far removed from the producing-oil districts where the cost of transportation must be added to the cost of fuel oil. This study also indicated that if a critical oil shortage exists, even in the Kansas City area, and burning oil is not readily available, then colloidal fuel may replace oil and 30 per cent of the deficiency in available fuel oil would be made up with the coal contained in the mixture. This would permit the substitution of colloidal fuel for burning oil with a minimum capital expenditure or inconvenience to the ultimate consumer because no appreciable capital investment would be necessary to convert from oil to colloidal fuel. The general use of colloidal fuel in place of fuel oil would conserve a large quantity of this currently critical commodity.

Application of colloidal fuel to locomotive fireboxes was studied in a cursory way and there seems much promise for its future use in this manner. The problem of paramount importance in this use is handling of fly ash. However, with proper design, this may be alleviated. Sparking would be practically eliminated, which would seem to make the fuel suitable for forested and mountainous areas.

First Patents in 1879

Colloidal fuel is not new. The earliest patents date back to 1879. This problem has been studied by capable men. In 1918 Bates made an important contribution when he made the first attempt to produce colloidal fuel commercially. During World War I the Submarine Defense Association investigated the possibility of utilizing this mixture of coal and oil. However, since the last war, due to the abundance of cheap coal, oil and natural gas, the interest in colloidal fuel diminished and it has not been until the last two years that this subject has again become important.

In 1938 the Engineering Experiment Station of the Kansas State College undertook new research work on this problem. Dr. J. H. Hedrick was placed in charge of the work and his first research was directed toward the utilization of various stabilizers. Four general types were studied: (1) dilute gels and gel formers; (2) emulsifiers; (3) petizers or solvents; (4) surface active agents. Under Dr. Hedrick, Stutzman determined the effect on viscosity and specific gravity of various coal and oil mixtures. Gradishar developed information on critical concentrations and flow of colloidal fuel through pipes. Later, Zabel continued the work started by Dr. Hedrick, giving emphasis to the study of stabilizers. And later, Landis studied methods of mixing colloidal fuel.

Early in 1943, as an amplification of the research work done by the Kansas State College, the development of a practical commercial means of producing colloidal fuel economically was attempted. This task was intensified by the growing fuel shortage in the Middle West. It appeared timely that the theoretical work should be put to a practical test. The author reviewed the work that had been accomplished to date. George Auer, attorney, reviewed in detail the patent situation surrounding this subject, prepared a complete bibliography, and read and analyzed all the available literature germane to the subject. Other technical men undertook the task of designing equipment and facilities to produce practically a satisfactory colloidal fuel.

This review of available information revealed sufficient incentive to explore further the practical applications of this general knowledge and pursue this problem through the pilot-plant stage. The laboratory investigation was then intensified. The coal puverizing facilities of the Western Minerals, Inc., plant near Baxter Springs were utilized to pulverize carloads of coal to various sizes. A pilot plant was set up in connection with the central cleaning plant of the Pittsburg & Midway Coal Mining Company at West Mineral, Kan.

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* Contributed by the Railway Fuel and Traveling Engineers' Association committee on Coal for the Association's 1945 year book.

† Combustion engineer, Pittsburg & Midway Coal Mining Company.

Colloidal Fuel Tried in Kansas City

After pilot-plant operation, carload samples of colloidal fuel were prepared and shipped in cars to Kansas City, Mo., where the fuel could be tested in modern boilers on a large scale. The tests were conducted in the Kansas City power plant of Montgomery Ward & Company by combustion engineers of the Pittsburg & Midway Coal Mining Company with the full co-operation of the combustion engineers of Montgomery Ward & Company and were observed by a representative of the Bureau of Mines. All physical and mechanical data were carefully observed and a complete boiler and fuel test was made in conformity with the code of the American Society of Mechanical Engineers, the results of which were recorded by the Kansas City Testing Laboratory. All results from the burning tests were eminently satisfactory. No particular trouble in any phase of the burning test developed which was difficult to overcome. The general result of this accelerated investigation up to and including the large-scale burning test may be summarized as follows:

1—A satisfactory colloidal fuel for commercial and industrial boilers and processing furnaces was produced with southwestern coal and mid-continent oils.

2—The colloidal fuel tested retained the same general temperature-viscosity relationship as that of the heavier grades of Bunker C residual oil. It was observed that less total heat and lower burning temperatures were required for atomization.

3—The use of an effective but inexpensive dispersing agent, when utilizing light residual oil, resulted in a more satisfactory and stable colloidal fuel and eliminated the necessity for extremely fine and costly grinding of coal.

4—The large-scale burning test of colloidal fuel demonstrated that it is possible to maintain higher continuous ratings with colloidal fuel than it is with oil alone. The flame is more satisfactory, is softer, more completely fills the furnace, and the cutting, impinging effect obtained with certain types of oils is not prevalent.

5—It was feasible and practical to handle colloidal fuel with ordinary heavy oil-burning equipment from the tank car through lines of ordinary size and in standard horizontal, reciprocating, centrifugal, and gear pumps. Colloidal fuel performed very satisfactory through tubular heaters, and in both outside mixing, steam and mechanical rotary burners.

6—Our experimental work indicates that additional research and development is necessary both on colloidal fuel and small burners before a fool-proof application of colloidal fuel can be made to the small domestic burner. The principal problem at this point is to develop a satisfactory and economical stabilizer that will assure the practical use of colloidal fuel made from light straw-colored or gas oils in the small domestic burner and at the same time not foul the burner orifice, the filter or the valves.

7—It was determined that, under present market conditions in the Kansas City, Mo., consuming area, the production of colloidal fuel would not attract private capital. This is true because of the low cost of coal and oil in the same territory at this time. It is obvious, however, that a well-designed and economically operated colloidal fuel plant in the Kansas City area could produce colloidal fuel for heavy and light industry where a price of $1.57 per barrel of colloidal fuel is permissible. This is predicated on the delivered price of oil at $1.07 per barrel and the delivered price of $3.64 per ton of bituminous coal.

8—The design and estimate for the colloidal fuel plant indicated that a minimum quantity of critical material would be required. Complete plans and specifications have been prepared. The estimate indicates that a plant to produce approximately 800,000 barrels of colloidal fuel annually would cost in the neighborhood of $614,000.

Analysis of 3,242 Patents

The analysis of the patent situation by George Auer, attorney, developed that since the inception of colloidal fuel there have been some 3,242 patents issued on various phases of the work. A cursory examination of these patents indicated that some 119 were worth careful study and analysis. Mr. Auer's investigation revealed the following general facts:

1—Stabilizing the mixed fuel received most attention. The greatest emphasis was placed on this problem and there is a sharp criticism of opinion existing as to whether fine grinding or the use of a suitable stabilizer is the best solution of this problem.

2—Little or no attention has been given to the development of new processes or arrangements for utilizing known equipment to best produce colloidal fuel.

3—A study of the foreign patents indicated that colloidal fuel has been used in a substantial way by the European nations.

4—There is no well-defined pattern for the study of colloidal fuel as revealed by the patents and there has been a general, disorganized search for a satisfactory solution.

Mid-West Economics

A more detailed study of the economics of the problem revealed some interesting facts. As we have previously mentioned, based on the present prices of oil and coal in the Kansas City consuming area, colloidal fuel can be prepared and sold for $1.57 per barrel. This is some 45 per cent more than the present cost of fuel oil and it is evident that so long as fuel oil is available at the existing price there would be little market for colloidal fuel. Our study indicates that if a price of residual fuel oil increased to approximately $2.75 per barrel, then colloidal fuel made from that oil would be competitive in price. The study also indicates that the utilization of coal, as such, under present market prices in Kansas City would be 67 per cent less expensive than colloidal fuel. Therefore, few consumers would continue to use oil or colloidal fuel if equipment for conversion to coal is available. It is obvious that from an economic standpoint colloidal fuel cannot be profitably produced in normal times in the Kansas City area. There, colloidal fuel would be useful only as an emergency wartime measure to conserve fuel oil. As pointed out above, however, this situation might not pertain in other consuming areas further removed from the source of fuel oil.

A detailed plant layout and estimate was made for a completed plant. This estimate was checked and indicated that a plant to make colloidal fuel would be relatively simple if carefully designed devices for proper mixing, storing and handling of colloidal fuel, such as those developed, were utilized.

It is particularly significant to point out that, due to the higher specific gravity of colloidal fuel, it will not float on sea water. This means that if colloidal fuel were used in place of oil for power-generating purposes on inland or ocean-going vessels, it would minimize the loss of life due to burns, particularly during a time of war.

EDITORIALS

Railroad Men Challenged

In a challenging address, presented before about 1,300 railroad and railway supply men at the October 15 meeting of the Western Railway Club in Chicago, Wayne A. Johnston, president of the Illinois Central, discussed the following text which is both appropriate and powerful and will need constant reemphasis in the months to come: "We must have railroads in and for America—solvent railroads, strong railroads, manned by alert and respected workmen, directed by progressive management, modernized to fit the needs of post-war America, operating under sound policies of government and commanding the confidence of the American people." It is obvious that this program, backed up by deeds, will give a tremendous boost to railway prestige and public favor and incidentally do as much or more than any other one thing to restore a normal high level of industrial activity.

In his definition of "solvency," Mr. Johnston contemplates that railroads will take in more than they spend; that they will have rates attractive to traffic yet fully remunerative; that they will pay good wages for good work; that they will buy and maintain a plant responsive to every call upon it yet be able to lay aside an ample return on investment, and be attractive enough to keep private capital interested in providing a continued supply of efficient tools. In other words, railroads will be enabled to stand on their own feet without governmental assistance of any kind, except constructive regulation, and serve as a stimulating example of accomplishment by private enterprise.

By "strong" railroads, Mr. Johnston refers not merely to those well equipped with track, power, cars and other physical facilities but to the necessity for railroads strong in character, ideals and enterprise which have in the past made railroads pre-eminent in the field of land transportation. He has a definite message for railway workers, including those in the mechanical department, in the following quotation: "These railroads must be manned by alert and respected workmen—people who are proud of being railroaders, who know that theirs is a public service fundamental to national well-being, essential, reward-worthy, truly a life worth living. These alert workmen must be so interested in the progress of the industry that they will speak up for it at every opportunity and share with management and public alike the thoughts, ideas and observations they develop with respect to better railroading. They must be a team—a thorough, co-operative, hard-hitting team—one well deserving of victory in the hardest competitive game for which American business can provide the opportunity and the reward."

For management, including supervisors, Mr. Johnston appeals for a progressive viewpoint from men who have come up through the ranks experienced in rebuffs, toughening and the hard knocks acquired only in rough-and-ready railroading. He says that this management must have vision, courage, enterprise and willingness to gamble, if need be, with everything except the safety of its men, customers and customers goods. It must also be willing to assume and bear responsibility, yet delegate it to capable subordinates and thus build a team and give it strength, spirit and genuine leadership.

To effectuate some of these highly desirable results, Mr. Johnston emphasizes the need for further improvements in operating methods, roadway and mechanical equipment, personnel training programs and employee suggestion systems, traffic building and solicitation and a great expansion in institutional and public advertising by railroads. The pre-eminence of "mind over matter" is implied throughout Mr. Johnston's remarks, as he reiterates his plea against "case-hardened habits of thinking" and says that railroad men must keep open, alert and inquiring minds, always ready to admit mistakes, but constantly willing to try new ideas and experiments and always press forward, even if going forward involves some risk and uncertainty and inability to see clearly the path that lies immediately ahead. It seems obvious that this mental attitude is more important now than ever before and essential to maximum results in railroading of the future.

Lowering Boiler Costs

In the all-welded boiler, in water treatment and blow-off systems, in construction details such as the application of flues and tubes and staybolts, and in the handling of the boiler in train service lie possibilities for both the reduction in boiler maintenance expenditures and better boiler performance. The Master Boiler Makers' Association, with a membership primarily concerned as craftsmen with fabrication and maintenance problems, presented available cost figures in some of the reports prepared for the Association's 1945 annual proceedings. This is the best way of getting action from railroad offi-

cers with a reputation for wanting to know how much can be saved by either new equipment or new methods.

Experience with the all-welded boiler has been limited because of test requirements and war conditions, but the elimination of boiler leaks, the savings in weight, and the absence of any shell repairs to the Delaware & Hudson's boiler, and the renewal of the firebox throat and flue sheets to this boiler in 1943 at 304,000 miles as compared to an average of 193,000 miles for 17 other locomotives of the same class, indicate large potential savings in maintenance expenditures. Approval has been given to the construction of all-welded boilers for two other railroads, in addition to another for the D. & H., and cost data should become available as this type of boiler becomes accepted as standard. That it will be is evidenced by the confidence of the association's committee that the construction of such boilers can and should be made a standard fabrication procedure.

In the report on water treatment, the statement is made that not less than $30,000,000 is saved annually by water treatment. This figure and the estimate that water treatment is in use at less than half of the water stations where treatment could be made with economy to the railroads should be reasons enough for surveying the possibilities of additional savings in this field. In seal welding of staybolts to eliminate leakage, in cleaning tubes and flues by washing instead of by blowing, and in methods used in applying tubes and flues the association committees have either shown savings figures or reductions in the maintenance work that can be translated into dollars saved.

By lowering the steam locomotive's maintenance costs, a large proportion of which is attributable to keeping the boiler in condition for maximum performance, the position of the steam locomotive with respect to competing types of power will be improved. In doing so corresponding improvements in operating characteristics and availability will result from the increase in boiler efficiency and the reduction in shop and enginehouse time required for boiler attention.

Train Radio No Longer Experimental

One of the last restraints to general application of train communication was removed by the Federal Communications Commission on November 14 when it released proposed rules and regulations for governing railroad radio service. The railroads were given a twenty-day period in which to present reasons why the rules should be changed and unless otherwise ordered by the Commission, the rules and regulations will go into effect on December 31, 1945. Few objections are anticipated and it seems improbable there will be any delay.

To avoid misunderstanding, the Commission's proposed rules begin with definitions of "railroad," "railroad radio service," "train radio station," "yard and terminal radio station" and "railroad utility radio station." Concerning licenses, it states that the license period shall be for two years, all licenses expiring at 3:00 a. m. eastern standard time on February 1. Those eligible for licenses are "persons or organizations operating as railroad common carriers." The rules add, however, that "experimental authorizations may be issued to communications common carriers for the purpose of providing railroad radio service." Some railroad operators would like to have this clause changed, since they see in it the possibility of an encroachment which might result in the railroads becoming the lessees of a service rather than having complete control of their own train communication service.

Construction permits are not required for radio stations on railroad rolling stock and provision is made for direct application for license for such equipment. Apparently identical sets may be interchanged between stations without the need of a new license.

A section of the rules on technical specifications lists specific channels, states that modulation shall not exceed 100 per cent on peaks, that with frequency modulation, the deviation of the carrier from the assigned frequency due to instability shall not exceed 30 kc. and that carrier frequency shall be maintained within 0.005 per cent of the assigned frequency. Provision is made for a railroad to make application for authority to use special emission for the operation of signaling, calling and similar devices. This opens the way for consideration of the use of radio in connection with C.T.C. and similar systems.

Under the heading, "Scope of Service," the rules afford the widest possible use of radio communication, allowing intercommunication by the railroads with other licensed radio stations in emergencies and the use of a single station by a group of railroads where this practice is desired.

A section of the rules on records lists those which a railroad radio station lessee must maintain. They are simple and the railroads should be able to maintain them without difficulty. The various tests which railroad radio service licensees are required to make are listed under a section on tests.

Miscellaneous railroad requirements, gathered into a final section, permit a railroad to use various methods in identification of stations, permit railroad employees to operate radio stations without radio operator licenses under conditions set forth in the order, and list inspection requirements. None of these will apparently involve any difficulty.

There still remains with the railroads the problem of obtaining equipment, of determining where communication may be employed to most advantage, in what type of service it should be used first and to what extent it should be applied. The latter requirement will be largely a matter of evolution, but if given some thought now future alterations will be simplified. The question of power supply, although involving types of equipment which are old in the service of railroads, is lagging

nd the development of the very new communication pparatus.

One thing pertaining to radio equipment which should ceive prompt attention is the matter of continuous mmunication in cuts and tunnels. It is felt by some at frequencies in the neighborhood of 2,600 mega-cles should be used, since in this range the narrow paces between cars and side walls serve as wave guides nd to a certain extent at least surmount this difficulty. he Commission has expressed its willingness to listen railroad requests for channels in this yet unallocated ection of the spectrum in case it offers special advan-ages.

Unfortunately, the equipment required for these high-r frequencies costs from two to three times as much s that for the 160 mc. range and such added cost would e an effective deterrent to the use of radio for train ommunication. Experiments now in progress indicate hat inexpensive means can be developed for effecting ontinuous communication with the already assigned requencies.

In addition to offering proposed rules and regulations or radio train communication, the Commission on No-ember 15 announced that it was considering the possi-ilities of relaxing the present low power rules govern-ng railroad carrier-current train communication sys-ems. These rules, which were issued originally to limit nterference caused by remote controlled tuning of broad-ast receivers, has caused the railroads some difficulty which a slight easing of the rules would remove and it is pparent from the Commission's statement that it will lo all that circumstances permit to promote the use of arrier type train communication. Given some relaxa-ion of the low power rules, carrier can give radio more effective competition. This should serve as stimulation to those who are promoting radio and help to effect rapid application of train communication. The Com-mission has been considerate, generous and intelligent in making its allocations, and it is important that the railroads make applications to justify and to hold the position they have been given in the communication field. Railroad operating improvements already effected would appear to offer sound economic advantages to considerable use of train communication.

A.A.R. Research On Counterbalancing

Probably in no single instance is the criticism of Amer-ican railroads for lack of modern research more fully refuted than in the case of counterbalance studies and tests conducted by the Association of American Rail-roads with a view to improving the operation of recipro-cating steam locomotives, especially in high-speed serv-ice. With ever-increasing emphasis on high-speed oper-ation in recent years, even with heavy trains, boiler ca-pacity was increased to make possible substantially high-er speeds and it became apparent several years ago that greater refinement in methods of counterbalancing loco-motives would be required for satisfactory steam loco-motive operation.

To meet this need and make a thorough technical study of the problem, a special committee was appointed by the A.A.R. and instructed to prepare a program of road tests under actual operating conditions, check the correctness of current methods and theory and finally develop a recommended practice as regards counterbal-ancing locomotives which would produce the desired re-sults in modern high-speed operation. This special com-mittee included representatives of both the Mechanical and the Engineering Divisions of the A.A.R. to assure the necessary co-ordination in interests of both track and equipment.

An extensive series of tests was conducted in the fall of 1941 and the summer of 1942 at Harvard, Ill., de-signed to show the effect on track and equipment of several different counterbalancing methods. Revolving parts were balanced on both the dynamic and static basis, with reciprocating compensation varying from 56 per cent to 0, equivalent to a reciprocating unbalance of 2.3 to 6.4 lb. per side per 1,000 lb. of locomotive weight in working order.

Three types of locomotives were tested, namely, 4-6-2, 4-6-4 and 4-8-2, and 495 test runs were made with speeds at 5 m.p.h., at diameter speed and at speeds as near 100 m.p.h. as could be obtained. A comprehensive report covering these tests and results, published by the A.A.R. in March, 1944, included a total of 319 9-in. by 12-in. pages replete with illustrations of special test equipment, charts, tables of test data and conclusions.

The very magnitude of this imposing volume pre-cluded its maximum use by mechanical department per-sonnel and particularly the shop forces who in the last analysis must understand and put into effect the desired improvement in counterbalancing practices. A Manual Committee, comprising representatives of the A.A.R., individual railroads and the three major steam locomo-tive builders, was, therefore, appointed to digest the com-prehensive and voluminous 1944 A.A.R. report and re-duce its findings to more condensed, usable form. The result was a concise pocket-size Manual of Counterbal-ance for Reciprocating Steam Locomotives, containing only 30 5-in. by 9-in. printed pages and made available to railroads generally by the A.A.R. Mechanical Divi-sion secretary's office only last month.

Preliminary reactions to the distribution of this small but authoritative discussion of one of the most impor-tant single features of steam locomotive design are high-ly favorable and the book promises to constitute a real contribution to improved locomotive operation. The A.A.R. is to be congratulated, not only on the thorough and competent way in which a modern research project of great importance has been carried on, but the effec-tive means developed to make results of the research generally available and usable.

Factors Affecting

Cinder Cutting of Boilers*

Railroads report on how to reduce and eliminate cinder cutting—Association study includes slagging of flues and tubes, and washing versus air blowing in flue cleaning

THE Master Boiler Makers' Association, in a letter to the chief mechanical officers of all the major railroads, requested a report on cinder cutting from each railroad for compilation into a committee report. It asked for information on the nature and amount of cinder cutting and the measures taken in the past and future plans to reduce or eliminate this costly item of locomotive maintenance. The reply from each railroad has been assigned a number and is quoted in the order received.

1—The greatest improvement we have noted so far in experiments which we have conducted has been due to an adjustment of arch heights. We determined that no great amount of cinder cutting is experienced with an opening between the arch and crown sheet of at least 130 per cent of the flue area. When the opening above the arch is less, cinder cutting very rapidly develops to a harmful extent. We have also observed that streamline surfaces on superheater parts reduce cutting.

2—On 4-8-2 class locomotives, most of the cutting is confined to the 2½- and 3½-in. flues located in the two outer rows on the sides and the bottom two rows. On the 4-6-4 class, cutting takes place in the 2¼-in. flues between the 5½-in. flues at the center of the back flue sheet, and in the two rows of 2¼-in. flues below the superheater flues. Crown bolt heads are cinder cut at the 14th row from the back flue sheet diminishing at the 5th row. Staybolt heads in center syphon, both sides, are cinder cut from the 9th row top in a half circle downwards about five rows. Considerable cinder cutting is experienced in the front end of this class. On the 2-10-2 class, cutting takes place in the 2¼-in. zone of flues between the syphon, two rows from the 5½-in. flues down. Very little cinder cutting is experienced in the front end.

Regardless of their condition, after stipulated mileage and at classified repairs, all open flues which are subject to excessive cinder cutting are removed and renewed using number 10 gage safe ends. Baffle brick applied to syphon-equipped Santa Fe Class locomotives has reduced cinder cutting as well as plastering.

3—Until about three years ago we had very little trouble from cinder cutting. However, after the application of stokers, which made it possible to supply the increased steam rate required to handle greater train loadings, cinder cutting became a serious problem. The cinder cutting in the neck at the front end of the Type A superheater units was the most serious and this has been practically overcome by the use of shields. Considerable effort was concentrated on the re-drafting of our locomotives and we have secured to some extent a better gas distribution through the tubes and flues. As a result the reduced velocity of the gases has also reduced the cinder cutting. This problem has not been eliminated and we are continuing to study the gas distribution because we feel that cinder cutting is a function of gas velocity.

4—In the past some cinder cutting of superheater unit bends immediately below ball joints at the superheater header was eliminated by installation of deflector plates and shields. Minor cinder cutting is experienced on the lower portion of the smokebox front end door on our large freight locomotives. There is also some evidence of cinder cutting on radial stay heads in the crown sheet between firebox syphons. We do not know of any remedial action for this condition. It is to be expected that some cutting must necessarily take place at that point because the gases, together with abrasive material, are carried over the brick arch in many instances at rather high velocity.

5—Prior to 1932 we had very little trouble from cinder cutting except on locomotives operating in lignite burning territory. After more intensive utilization of steam locomotives was inaugurated and appurtenances were introduced to obtain higher capacities, damage from cinder cutting began and its seriousness has increased with the progress made in obtaining full use of the locomotives.

We have not resorted to any of the numerous short cuts proposed to minimize this trouble, such as a change of brick arch, welding protecting beads on staybolt and crown stay heads, heavier ends on flues and front end changes, but have confined our efforts to making repairs to affected parts before such time as experience has shown that failure may occur.

It is our opinion that cinder cutting is the result of the high firing rates required to get maximum capacity of locomotives and is influenced adversely by the type of coal used necessarily for stoker-fired locomotives. It is very questionable in our minds if there is any net saving in changing appurtenances as experience has shown their fuel saving values and we are convinced that the damage

* Abstract of a report prepared for the 1945 year book of the Master Boiler Makers' Association.

rom cinder cutting does not justify increasing the fuel ill or reducing the locomotive's capacity. We think he best method of control is to make repairs to cinder ut parts at such periods as experience has demonstrated ailures may occur.

6—Very little cinder cutting of flues and firebox sheets s experienced on our locomotive boilers. There is slight utting of crown bolts and staybolt heads in the two top ows on right and left sides of Thermic syphons. This as been reduced by arc welding a bead at rear of the olt with the boiler full of water. We have followed his practice for several years with no damage to the heets.

On 2-8-4 freight locomotives some cutting occurred fter approximately 130,000 miles of service. The abraive action takes place inside the tubes at the prosser mark n the outside rows of tubes. This trouble has been practically eliminated by leaving the two outside rows of ubes unprossered. Cinder cutting in the smokebox, especially on the front door and smokebox ring was liminated by the installation of a baffle.

7—Atlantic region: No cinder cutting in firebox, with he exception of a few staybolt heads in the upper portion f syphons. Very little trouble with tubes and flues. Most of the cinder cutting occurs on the front bends of uperheater units in the smokebox and on smokebox ront door and ring rivets. These are being protected y suitable shields or baffles. Central region: Some cinder utting on staybolt heads on the inner side of syphons at he top front area, necessitating staybolt renewal about very four years. The front end bends of superheater nits in smokebox and the smokebox front door and ring ivets are subject to cinder cutting, but are now protected by suitable shields and baffles. Western region: taybolt heads in the upper portion of syphons subject to he same cinder cutting as experienced on the Atlantic nd Central regions, also some cinder cutting of crown olt button heads in the front area of the crown sheet head of the brick arch. Superheater flues show a tendency to cut close to the return bend of the superheater nit, and the effect on the superheater unit front bends in ne smoke box is similar to that found on other regions. Eastern lines: Very little trouble from cinder cutting. Western lines: Experiencing some trouble with cinder utting of staybolts and crown bolts and with side tubes n locomotives equipped with the Type E superheater.

In our opinion the most essential condition to prevent inder cutting is the correct drafting of the locomotive to btain the lowest gas velocity consistent with free steaming. On some locomotives the condition was greatly improved by the adoption of the A.A.R. Master Mechanic's ront end and the correct proportioning of gas areas in ccordance with the A.A.R. recommendation. In the ront end, superheater unit shields are used to protect the nits, and baffles to protect rivet heads, etc., but any ttempt to use baffles in the firebox itself has merely resulted in the cinder cutting being transferred from one cation to another.

8—There has been some cinder cutting of staybolt heads n crown sheets and the fire end of the small flues of our 8-2 and 4-8-4 locomotives. We have tried several ethods of overcoming this trouble, but have nothing nclusive to report at present.

9—We were having a number of flue failures caused by nder cutting, mostly in passenger power, which we tributed to a lack of spacer brick between the flue sheet nd brick arch and after going back to the spacer brick nd applying seven rows of brick to the arch very little ouble has been experienced.

10—Our 2-10-4 coal burning locomotives built in 1937 gave us some concern when new by starting to cut the heads of crown sheet staybolts. We applied electric beads back of the bolt heads in the affected zone on a few locomotives, but later we lowered the brick arch and the cinder cutting stopped. We have no cutting in the firebox or on flues. Superheater units are protected by shields and shields are also applied to the feed water heater piping in the front ends of the 2-10-4 coal burners.

11—Cinder cutting in our boilers has never been a major problem, mostly due to the grade of coal used and the drafting arrangement. Our renewals because of cinder cutting is very slight as protection of affected parts has been very successful. Fireboxes, when applied, have a bead of weld placed in front of the bolts and radials in the known areas affected by cinder cutting and additional welds are made, if necessary, while the locomotive is in service. We have eliminated the prossering of the 2¼-in. flues of all combustion-chamber type locomotives in the areas most affected, which has resulted in longer flue life and reduced cutting to a minimum. Cinder cutting in front ends of locomotives has always been more pronounced and requires considerable maintenance. Baffle plates and shields are used to protect the various parts affected, mainly the superheater units, smokebox front and steam pipes. Netting, when necessary, is either patched or renewed.

12—We were not experiencing this trouble a few years ago but cinder cutting is now a serious problem in our stoker-fired locomotives which, in my opinion, has been brought about by various changes having been made in the locomotives. Changes consisted of application of stoker, increasing the exhaust cavities in nozzle base, larger exhaust tip, larger stack and extended lift pipe, sealed arch, and increased steam pressure. These changes resulted in a much more efficient locomotive, as we were able after such changes to efficiently handle heavier passenger trains and increased tonnage on freight trains at increased speed. The increased consumption of fuel results in a large amount of partially burned particles of fuel and cinders to pass over the arch at very high velocity which results in a sand-blast effect on the various parts.

Recently we eliminated the sealed arch on two of our heavy Pacific-type locomotives for test purposes, applying four-inch spacer bricks, and practically eliminated the cinder cutting in the firebox zone, the burning and fire cracking of the flue beads, the excessive burning of the back ends of superheater units, and the accumulation of slag on back tube sheet. We obtained the same results on Mikado-type locomotives on test and we have now adopted the open arch on all stoker-fired locomotives.

13—On 2-8-8-2 type locomotives the flues in the top central portion cut through on the bottom just inside the back flue sheet at the shoulder formed by prossering at approximately 50,000 miles. Discontinuing the prossering increased the mileage to approximately 150,000 miles. The top central portion of the back flue sheet and the crown bolts over the top of the arch have to be renewed at approximately 300,000 miles. While no means have been found to eliminate renewals, they have been reduced by maintaining a full brick arch. The sides of the smokebox have to be patched at approximately 200,000 miles.

On the 2-6-6-4 type locomotives the back flue sheet has to be patched at the top or renewed and some of the crown bolts have to be renewed at approximately 450,000 miles. Some superheater flues have to be renewed at approximately 450,000 miles due to cutting by the deflection of cinders at the supports for the superheater units.

14—We have had serious cinder cutting of flues, front end appliances, superheater coils, and smokeboxes which we have endeavored to overcome by manipulation of the

brick arch. The changes cause the locomotive to steam poorly and if it does steam properly, we experience cutting on crown staybolt heads and crown sheets. In some cases we have been able to overcome cinder cutting by enlarging the nozzle opening to the largest extent consistent with good steaming. On nozzle tips equipped with a four prong bridge, flues are cut faster than with a ⅜-in. or ½-in. round or diamond bridge installed parallel with the cylinder. We are increasing the size of nozzle tips where possible and installing round or diamond bridges. It is believed that a good deal of our trouble is caused by our coal which has a very high and hard ash content.

15—We shield parts when cutting takes place, but this does not stop the cutting and it is a continuous job to renew shields. The open tubes and flues located at the sides and bottom of the flue sheet are cut most with very little cutting of the flues and tubes located in the center. It is our practice to run flues and tubes until cinder cutting is noted. Then thimbles are applied. Flues and tubes that have had thimbles applied sometimes cap and slag over and cinder cutting then develops in the other flues. A few locomotives have been equipped with unprossered flues and tubes which has prolonged the life somewhat. Cinder cutting of units is prevalent particularly in the top row. The Type E units cut more than the Type A.

The cinder cutting of staybolts has been reduced by increasing the distance from the arch to crown sheet. When our Class S freight power was first placed in service the brick arch contained 10 rows of brick, and cinder cutting of crown and syphon staybolts was experienced. The arch was reduced to 8 rows of brick which practically eliminated cinder cutting of staybolts. Some cutting occurs on crown bolts between syphons. Our method of protection is to weld a bead of weld part way around the head of crown bolts.

In passenger locomotives of the 2-6-2 type that are used in through line service the cinder cutting takes place in different locations on the tube sheet and flues. They are all equipped with the same nozzle, ashpans, and grates. We shop them after Class 3 repairs at 84,000 miles for a Class 5 repair, with no flues removed; the next shopping at 168,000 miles with part flue removal; the next shopping at 250,000 miles with full flue removal. At this time some of the 5½-in. superheater flues are cinder cut inside where the back unit band rests on the flue; the cutting action is at each side of the band. We apply long safe ends or renew the flues. The 2¼-in. tubes are cut at the sides and top of the flue area on the passenger power and in the center of the flue area on other power. Our only preventive is to apply shields or thimbles in the 2¼-in. tubes in the firebox end and shields in back of headers toward the front tube sheet to prevent the cutting of headers. Our boiler fronts are all shielded to prevent cutting.

16—On this railroad cinder cutting of tubes and flues occurs generally between 80,000 and 100,000 miles. Thimbles are applied on the inside of tubes and flues after they have made approximately 60,000 miles to prevent failures at a later date. Cinder cutting on tube sheets is nil. We have some cinder cutting of crown bolts, staybolts, and of syphon staybolts in the top front section of the syphon. To overcome cinder cutting of staybolt heads, half moons are electric welded within ⅜ in. of the staybolt head, thereby deflecting the cinders so they do not come in contact with the bolt heads.

Cinder cutting of both Type E and Type A superheater units is most noticeable on the vertical section of the unit in front of the small flue holes. We have installed baffles in front of small tubes on a few locomotives in test, and it appears that this arrangement may have merit but the tests have not run long enough to draw any conclusions.

A cinder deflector applied in the smokebox to reduce cinder cutting of the boiler front has not only protected the boiler front but also caused an unexplained decrease in cinder cutting of staybolt heads as it is reported that we are finding a smaller number of half moons that require renewal on monthly inspections.

17—Our history on this topic indicated that we should first consider the locomotives that are assigned to the task of moving the tonnage over the districts at a higher rate of speed which, in this sense, has increased the rate of evaporation and likewise has affected the cinder cutting action caused by the abrasive action of the ash contents of the coal used on different districts. Therefore, when comparing, for instance, the same design of locomotives without combustion chambers on two different districts using different types of coal, we have been confronted with differences as to the locations of cinder cutting and the abrasive action on the parts involved as follows:

District No. 1—The cinder cutting was more noticeable on radial stay heads and the top 18 in. of back flue sheets. The flues within this area and the superheater units were also affected.

To prevent the excessive cinder abrasive action various tests were conducted. Removing the top row of brick from arch increased fire hazards and increased fuel consumption, but the cinder cutting was somewhat reduced, however, not with sufficient merit to warrant the loss of the increased cost of fuel.

We have lowered the back end of arch tubes to permit a greater area between the crown sheet and top back row of arch brick without changing the length of arch from back flue sheet. This has helped to reduce the abrasive action at radial stays and is considered a step in improving the design to further prevent the abrasive action at fire ends of radial stays and has not affected the fuel consumption. Some changes were made in the size of exhaust nozzles but the increases in nozzle size affected the steaming qualities and the exhaust nozzles were changed back to the original size.

Radial stay heads have a welded bead applied (in half circle design) approximately ¼ in. wide and about ½ in. back of each radial stay. When this welded bead is worn off (about once every year) the bead is again built up to standard. The bead has also helped to break up the cinders and slightly reduced the abrasive action on the fire end of flues and back flue sheet, although the cinder cutting is still prevalent on these parts.

The superheater unit shields at front end have been increased from 3/16 in. to ¼ in. in thickness which has helped prolong the life of shields between replacements. The superheater header is protected by a ½-in. plate attached across the top of superheaater units and so shaped and applied as to not restrict the draft through the top flues. It is attached about 6 in. ahead of the flues and close to the header and bent at about an 80-deg angle which deflects the cinders downward from the superheater header. These plates or shields are renewed as they become worn (about each general shopping of locomotives). The interior surface of the smokebox where the abrasive action is most severe has a ½-in. liner welded to the area involved. These plates will last from 7 to 8 years. The protective measures have not interfered with the steaming qualities of locomotives and have not interfered with the fuel performance, both of which are of prime importance, and we find them to be the most

fficient method of combating the cinder action in this istrict.

District No. 2—We are confronted with a slightly ifferent condition because of the different coal used with ıe same class and design of locomotive. A honeycomb evelops on the back flue sheet and a stoppage of flues ccurs throughout the entire flue area. The latter starts ıostly in the center of the flue area and thus deflects the ases at high velocity through the outer rows of flues :hich subjects them to cutting by the high ash content of he coal. This grade of fuel does not have the severe brasive action on radial stay heads as encountered on)istrict No. 1. Baffle plates applied in the front end at :ach side of the smokebox transferred some of the cutting ction to flues in the next vertical row on each side. Consequently, we removed the baffles in some instances ınd have experimented with applying thimbles or bush-ngs in flues in each outside row and renewing those found inder cut at each monthly inspection. This method has ıelped and has not interfered with the steaming qualities)f locomotives, and it has prolonged the life of flues be-ween resettings of the flues involved. It has also in-reased the availability of locomotives to a certain degree.

We have several locomotives equipped with Circulators ınd due to the shape of the brick arch it has reduced the :inder cutting on flues slightly. In this district we are ılso confronted with superheater unit bands becoming)urned and badly distorted which interferes with draft :hrough superheaater flues and increases the draft velocity :hrough the smaller flues after the superheater flues be-:ome plugged, particularly on the locomotives assigned :o long runs. Locomotives equipped with front-delivery stokers have less carry over of cinders into the flues resulting in less cinder cutting. Results of tests indicate that the discharge of cinders from the stack are about one-third less for front-delivery stokers as compared with rear-delivery stokers.

Therefore, based on our experience we have reached the conclusion that in each class or design of locomotives the type or grade of coal and the operating conditions are at times the governing factors. No one standard method of stopping the abrasive action can be adopted and affected parts must be protected wherever it is practical to do so.

18—Cinder cutting has been one of our greatest sources of trouble in firebox maintenance, especially in the past four years. Crown stays, syphon staybolts, back end of combustion chamber syphons, smokeboxes, boiler fronts, saddle bolts, steam pipes, feedwater heater pipes in smokebox, and particularly tubes and flues have been cut.

We have tried various methods for the protection of parts being cinder cut, but nothing much has been done to prevent or eliminate the causes of cinder cutting. The use of crown sheet baffle brick helped a little, but the trouble of keeping brick in place more than offset the benefit derived from its use. Thimbles are applied to tubes on both sides of superheater flues which stopped the cutting of tubes, but increased the plugging of tubes. Heavier gage safe ends were tried, but started to crack 25 per cent sooner than the standard safe ends. The electric welding of a bead on the back side of crown stays deflected the cinders and stopped the cutting of crown stays. On cinder-cut parts of boiler fronts, steam pipes, and feedwater heater pipes, ⅛-in. and ¼-in. shields are applied to the affected parts, and run from two to three shoppings before renewing.

The most serious cinder cutting, on passenger power at 120,000 miles, was the cutting through of the tubes between and on both sides of superheater flues. The application of Tuyere grates, which has a tendency to baffle and soften the flow of air through the grate, has reduced the cinder cutting to some extent.

Previous to 1941 cinder cutting was very light, but due to increased speed and heavier tonnage of both freight and passenger trains, the firing rates were increased to obtain maximum boiler output. The higher firing rates produced high gas velocity and more cinder cutting because of poor combustion. In order to overcome or reduce cinder cutting, we must have good combustion.

One of the most important items in controlling cinder cutting is the proper cleaning or blowing of flues and tubes. This cannot be over-emphasized, because it has been found that locomotives of the same class that have had flues and tubes kept clean from shopping to shopping, have had far less cinder cutting than those that have had flues and tubes partially plugged.

We have tried numerous arrangements of smokebox plates and different sizes of smoke stacks and extensions. In most cases, they did not prove of much benefit.

19—We have practically no cinder cutting on the firebox sheets, crown stays, or staybolts. Cinder cutting in the interior of the smokebox around the heads of cylinder bolts is minor when considering the long life of these parts before renewals. The traces of cinder cutting in the firebox have been directly over arch brick on the crown bolts. We believe cinder cutting was due to restrictions at this point and the low diaphragm plate. With removal of these restrictions, the condition improved, and cinder cutting disappeared. The openings at these points should be equalized and be large enough to allow the lowest possible gas velocity attainable through the flues that will maintain good combustion for the locomotives.

20—When cinder cutting first began to become alarming, a check was made on one district maintaining 122 heavy freight locomotives and 74 passenger locomotives to determine the number of open flues and tubes subject to cinder cutting that it was necessary to remove at inspection periods to prevent flue failures. It was found that 3,273 flues and tubes had been renewed, the average life being approximately 45,000 miles.

A check on the same district was again made after cinder baffles had been applied to the open flues and tubes that were subject to cinder cutting, which developed that it was necessary to remove 1,396 flues and tubes in a like period, a reduction of approximately 57 per cent, the average life being approximately 65,000 miles before renewals were necessary to prevent flue failures. Also, more attention has been paid to flue cleaning and lately we have started to wash flues.

Report of E. E. Owens

As an addition to my paper on cinder cutting for last year the following data will cover our experience since that time:

Our latest 4-6-6-4 type locomotives built in the latter part of 1944 are the same as the 4-6-6-4's built in 1942 and 1943 but have Type A instead of Type E superheaters, and have a Circulator in the combustion chamber in addition to the five in the firebox to prevent cinder cutting wear on the back flue sheet and flues.

After these engines were in service for 90 days a close inspection was made for evidence of cinder cutting damage. It was noted flue beads were polished and some wear just inside prosser mark on side wall of the tubes. This cinder wear progressed rapidly and at about 35,000 miles we applied thimbles in outside rows of the 2¼-in. tubes to enable us to keep them in service until necessary to shop for machinery repairs at approximately 60,000 miles. At that time we found it necessary to change 28 superheater flues and 75 tubes at the top and the sides of

the flue sheet due to the cinder cutting. It was necessary to protect the Circulator riser tubes by welding on ⅜-in. round rods to the back side extending from the crown sheet downward 16 to 18 in. and to weld shields back of the staybolt and crown bolt heads over the arch to protect the bolts and prolong their life. We merely concentrated the cinder wear to different areas and proved no prevention had been obtained.

In contrast, the Mountain-type locomotive in passenger service which has four Circulators in the firebox and one in the combustion chamber, referred to in my 1944 report, had approximately 300,000 miles without removal of any flues due to cinder cutting. However, this locomotive was shopped for Class 4 repairs in March, 1945, and we changed a total of 110 flues and tubes. Six superheater flues and 54 tubes account of cinder wear and the balance of the 110 were changed to clean out and condition all flues and tubes to go the 4 year limit which will be in March, 1946. This engine now has 390,000 flue miles and proves that Circulators properly located in fireboxes are beneficial in prolonging life of flues and tubes against cinder cutting wear. In view of the above performance, we possibly have a combination in this firebox that can be worked out to solve some of the trouble experienced from cinder cutting on our heavier power.

Slagging of Flues and Tubes

In a report on the slagging of flues and tubes S. F. Wentz, special piecework inspector, New York Central, stated that slag is not directly chargeable to poor firing but it will start and hasten the spread of slag and clinker. He noted that methods used in firing coal from various territories are basically the same but in firing coal with a high percentage of iron, silica, lime, and suplur, the fire should not be disturbed any more than is absolutely necessary with the grates being rocked slightly and frequently.

E. E. Owens, general boiler inspector, Union Pacific, reported that slagging of flues and tubes on MacArthur and heavy Pacific type locomotives started in the fall of 1944 when Illinois coal was used because of the high war tonnage. These locomotives would arrive at terminals with the flues and tubes honeycombed over. Brick arches that previously gave 30 days of service, when burning western coal, were being replaced in 15 to 20 days and it was necessary to clean and blow the flues each trip. The air openings in the grates and front end drafting were not adapted to the fuel and the slagging was aggravated by the slightest leaks in the fireboxes and front ends. The condition was corrected by the mixing of Illinois and Wyoming coal in equal proportions.

Cleaning Flues and Tubes

By S. F. Wentz

There are two methods used in cleaning flues and tubes. The first and old method is by blowing the flues and tubes with compressed air and the second and recommended method by washing the flues and tubes with water and air. The number of flues and tubes that require cleaning is noted on the work report showing the number plugged solid and the number partly plugged. All flues and tubes that are plugged solid, all flues and tubes partly plugged above and below the units and all return bends of units that have a slag build up on the ends should be marked to be cleaned. Fig. 1 shows a tyical slagged flue sheet and plugged flues.

When an oil torch is used to candle the flues and tubes, those that are only partly plugged and the units that have a slag build up on the ends will draw the flame which results in some of the flues not being marked for cleaning. It is a better practice to use a flashlight with a good focus to examine flues to see if they are plugged in the front end or above or below the units or if there is a slag build up on the ends of the units. Units that are warped or have turned up or have missing unit bands should be replaced.

The flue cleaner should remove the loose cinders from the flues at the firebox end, the slag from the ends of the units with a hook, and any crust of unburned coal that is sometimes formed around the interior of the flues at the firebox end. A ⅜-in. flue-cleaning pipe, at least one inch longer than the flues that are being cleaned, Fig. 2, should be used with not less than an air pressure of 100 lb. per sq. in. The flue-cleaning pipe should be inserted the full length above and below the units on flues that are equipped with superheater units and the full length on the open flues and tubes as shown in Fig. 3. When a short flue-cleaning pipe is used, it only blows out the flues at the firebox end and tends to plug the front end of the flues more solid. After the flue cleaner has completed his operation the flues are again examined by the inspector to see if the flues and tubes are properly cleaned, marking any that do not pass inspection for recleaning.

The second method of cleaning flues and tubes with water and air differs from the first method as it is only

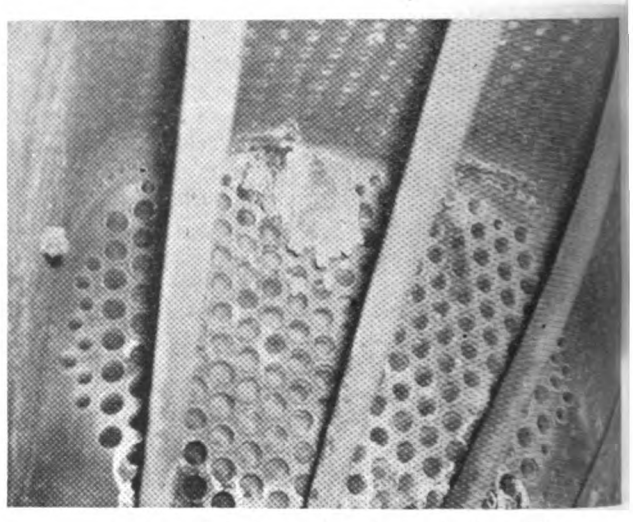


Fig. 1—Typical slagged flue sheet and plugged flues

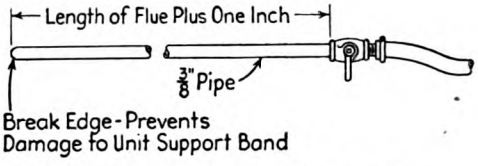


Fig. 2—Flue-cleaning pipe of correct length

necessary to hook out the loose cinders and the slag from the ends of the units so the flue washing machine, Figs. 4 and 5, can be inserted in the flues. It is necessary to blow the flues that are plugged solid to get a passage through them prior to washing. If an attempt is made to wash a flue that is not partly opened, the accumulated pressure should immediately be released by opening the bleed-off pet cock before the locking lever is released to remove the flue washer from the flue.

The washing machine is inserted in the flue and the operating lever pulled back to the locking position, Fig. 6, which tightens the machine in the flue. The water hose is connected from the washout line, which should be not

ver 120 deg. F., to the washing machine and the air ose connected. An air pressure of at least 100 lb. per q. in. should be used. The cleanout plug is removed from he bottom of the smokebox and a funnel welded to a lue is placed underneath the cleanout plug hole, the flue

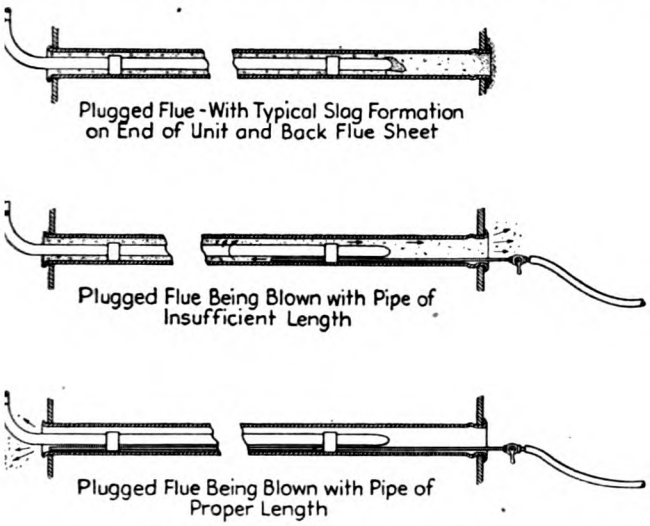


Fig. 3—Method of using flue-cleaning pipe

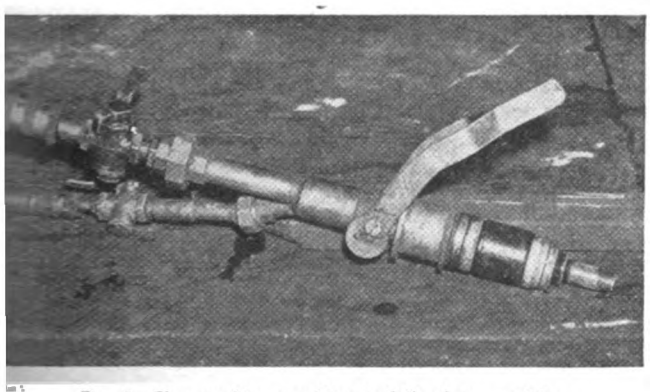


Fig. 4—Flue-washing machine in full release position

xtending to a box on the floor or mounted on a wagon f the desired size which is placed in front of the locomo- ive to catch the water and cinders and prevent the inders from going into the drain in the pit as shown ı Figs. 7 and 8.

Washing should start at the top row of flues, working cross the flue sheet and then continuing with succeeding orizontal rows to keep water and dirt from leaking ıto flues already washed. The water cock valve is pened for several seconds; then the air is turned on for few seconds allowing the air and water to pass through he flue and remove the accumulation contained therein. The water is then turned off and the air allowed to blow for a few seconds more to remove the water and dry the flue. The time required to keep the water and air on depends on the accumulation inside the flue and after a few flues have been washed the flue cleaner can judge the length of time required for each operation.

Passenger locomotives running on one road had to have the flues blowed about every round trip to prevent low steam failures on account of plugged flues. The railroad started to wash flues with a flue-washing machine similar to the one shown in the 1943 proceedings and after making a test, it was found that the flues required no cleaning in a 15-day period and in several instances only three flues were found plugged after being in service for a 30-day period after the flues had been washed.

There are several advantages in washing flues; it is a quicker and easier operation; the flue cleaner does not have to contend with the soot and dust, and all the soot, an excellent insulating material, is removed from the flues and units. Also, while the flues are being washed the accumulation in the front end is thoroughly removed.

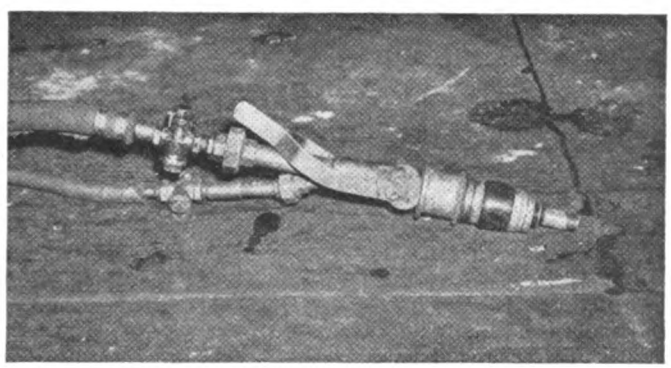


Fig. 5—The rubber bushing expands to hold the machine inside the flue

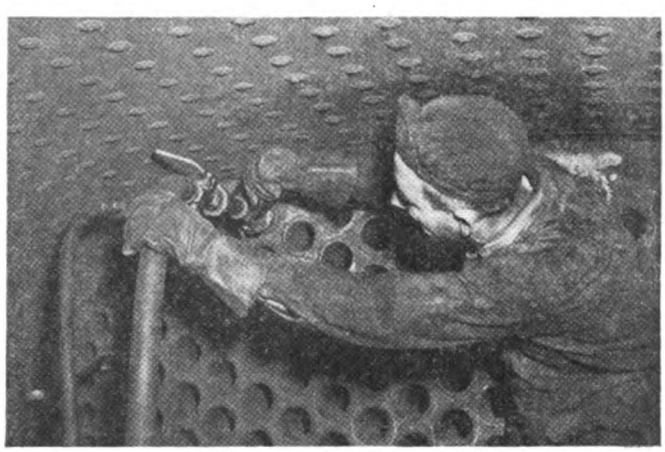


Fig. 6—Locking the flue-washing machine inside the flue

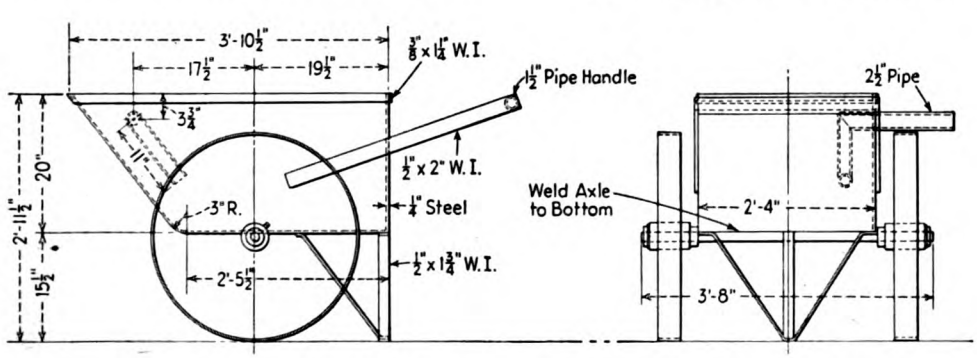


Fig. 7—A wagon designed to remove cinders from the water and to carry them out of the shop or enginehouse to the cinder dump

Another railroad washed the flues on seven locomotives in passenger service and after making one round trip the flues were examined. Five of the locomotives making 1,176 miles had a maximum of three flues plugged and none honeycombed per locomotive and the other two locomotives making 806 miles had no flues plugged and four

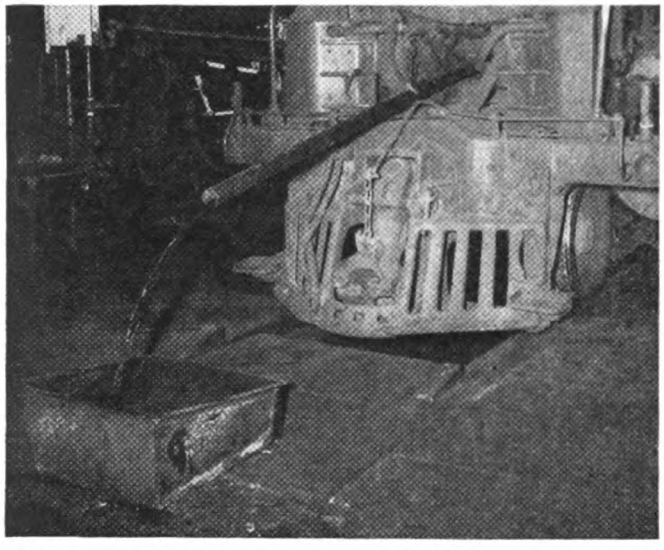


Fig. 8—A box separates cinders from the water draining into the pit

flues honeycombed. Eleven locomotives averaged 9,801 miles each in one month before it was necessary to again wash the flues.

From the tests made on washing flues, it appeared that much better results were obtained from washing the flues than by blowing them with compressed air.

Washing Flues

By E. E. Owens

In regard to washing and blowing of flues, we have obtained good results from washing flues and tubes at each monthly inspection period and have reduced complaints of engines not steaming as much as 80 per cent by washing each flue and tube under pressure once a month.

We use a combination washout nozzle with air line to blow out the flues and tubes. The washout nozzles have a tapered oak plug to fit the size of flue being washed to prevent the water coming out the back end as considerable pressure is obtained. A 3-in. washout plug is applied to the bottom of the smokebox to drain out the water. We also use a washout nozzle with rubber ferrules which are expanded inside the flue by a screw arrangement. We have used this nozzle over a period of months and have found no flues completely stopped up between inspection periods. However, the wooden oak plug was resorted to as the time consumed in washing a set of flues was greatly reduced and a satisfactory job was accomplished.

Conclusion

The Master Boiler Makers' Association is deeply indebted to the mechanical officers who have contributed to this topical report, and, in conclusion, your committee is of the opinion that cinder cutting to some extent is here to stay, it has increased a great deal in recent years under present day operating conditions because the flow of cinders at high velocity through the locomotive boiler can never be entirely eliminated, the cutting action is insidious and takes place over a period of time; therefore, it is not easy to observe and correct before damage is done. The proper thing to do is to anticipate such conditions and set up a strict program for prevention by proper design, maintenance, and operation.

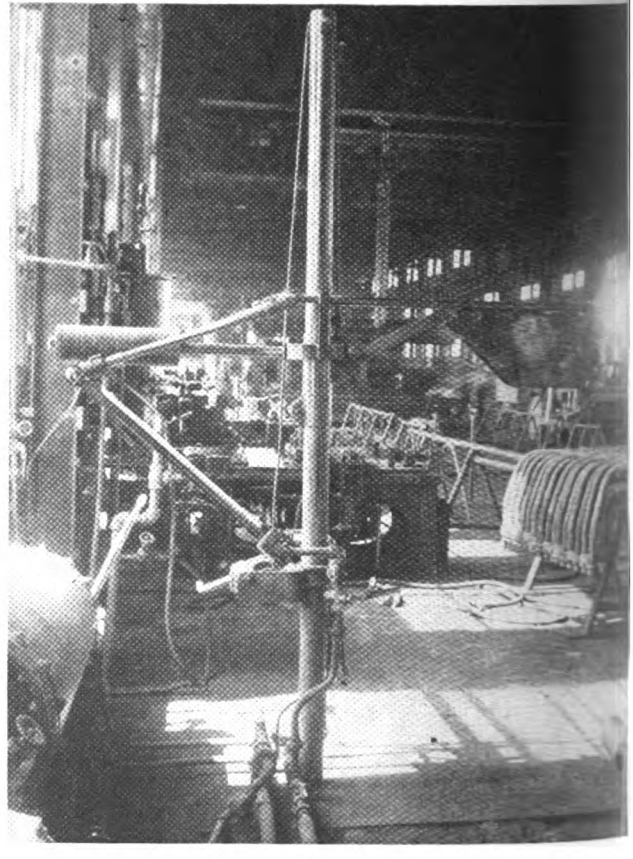
The report was signed by E. H. Gilley (Chairman), general boiler foreman, Grand Trunk Western; E. E. Owens (Vice-Chairman), general boiler inspector, U. P.; S. F. Wentz, special piece work inspector, N. Y. C.; A. P. Robersen, district boiler inspector, Gr. Nor., and Wm. Henry, general boiler inspector, Can. Pac.

Testing Device For Superheater Units

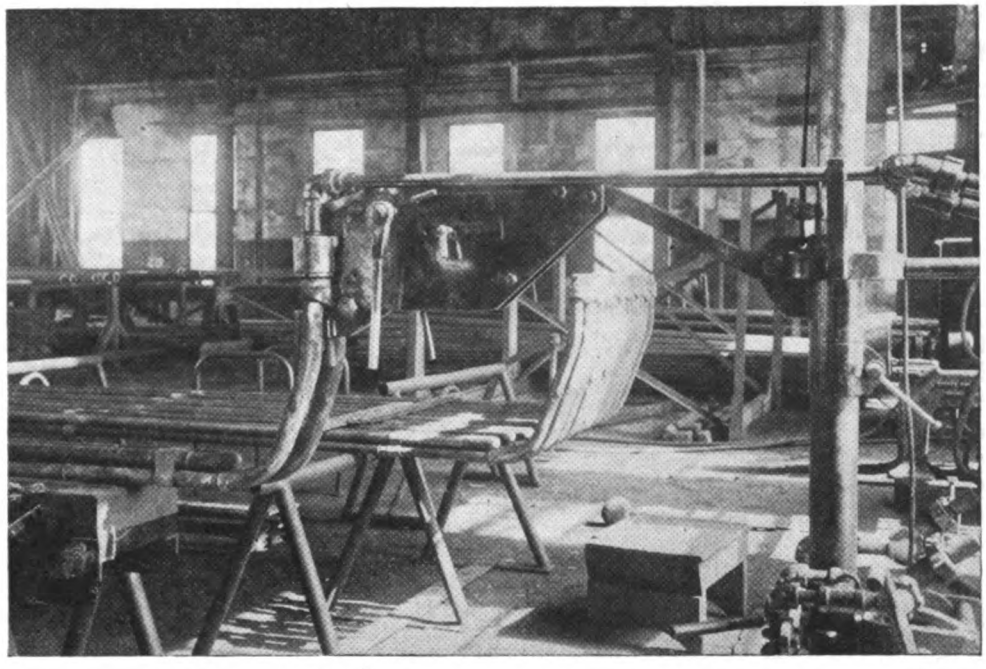
An ingenious arrangement for quickly applying a water test to superheater units before they are reapplied has been developed at the Springfield, Mo., locomotive shops of the St. Louis-San Francisco.

Referring to one of the illustrations, it will be noted that the pressure head at the right of the machine is bracketed to a sleeve which carries a 1-in. round bar extension and counterweights at the left. This sleeve is capable of vertical adjustment on a 3-in. standpipe, 8 ft. high, by means of a hand winch and ratchet. When raised to the proper elevation for the particular superheater units being tested, the sleeve may be tightened by setting up a hand screw, which clamps the head firmly in position.

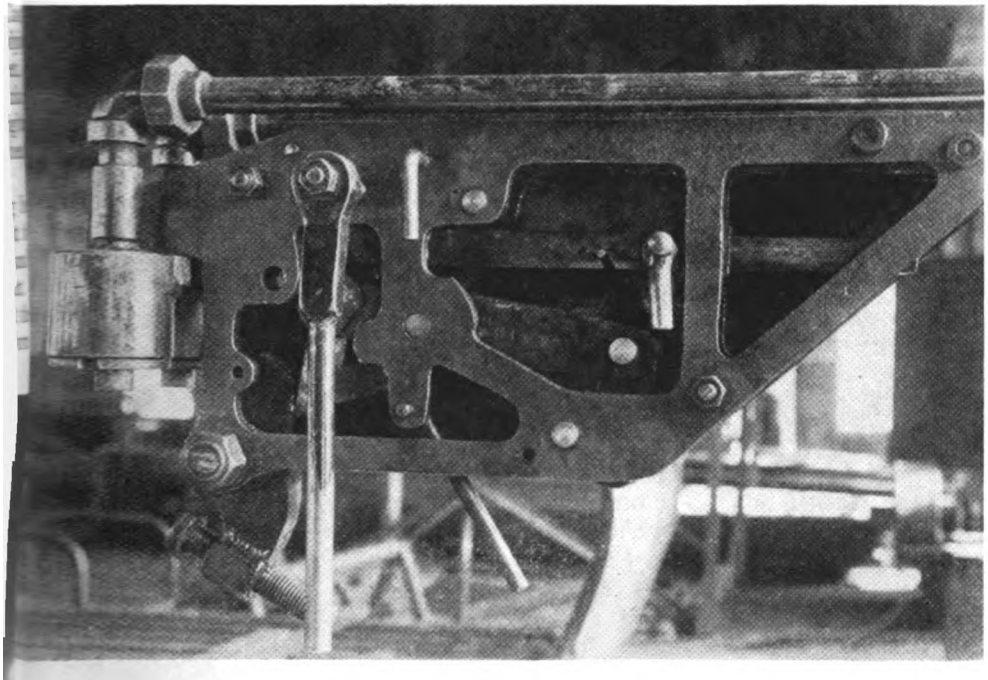
The upper horizontal support of the testing head consists of two lengths of 1-in. pipe connected at the outer end to the pressure head of the machine and at the standpipe end to Barco flexible metallic joint. Six of these flexible joints, in all, are used to connect the double line of short, straight pipe sections which form the A-



The pipe connections to the superheater-unit testing device



Testing head with superheater unit in place



Details of clamping lever arrangement

shape shown and serve to transmit water or air from supply pipes connected to the floor lines to the upper horizontal pipes and head of the test machine. It is obvious that use of the six flexible metallic joints, as installed, permits the testing head to be raised or lowered and still maintain tight steel pipe lines necessary in carrying the heavy water-test pressures.

Water is admitted through one of the pipe lines to the testing head at city-line pressure until the superheater unit has been filled, at which point a valve on the other line is closed and the test pressure raised to 700 lb. by means of a booster pump mounted on the shop wall and arranged to be cut in on the supply line when desired.

The superheater unit is hammer tested, the booster pump cut out, a valve on the outgoing pipe line opened and shop air at 80-lb. pressure admitted through suitable valves and pipe connections to blow all water out of the superheater unit and permit this water to be drained to the sewer. Water delivery to the testing machine is made through a 2-ft. by 5-ft. reservoir to avoid water hammer and give quick delivery of the water.

Particular interest centers about the method of clamping the superheater unit to the pressure head of the machine. Details of the head with side plate removed show the clamping mechanism. Dual outlets in the pressure head are leather packed to make a tight joint with the two ball seats on the superheater-unit pipe.

In operation, the counterweighted pressure head is simply brought down on the unit to be tested and the rocker arm with adjusting screw revolved by hand until the head of the screw comes up under the unit equalizer. Operation of the vertical handle then acts through the series of levers shown to develop an upward pressure on the holding screw at a ratio calculated to be 350 to 1. A quick-acting feature built into this holding head consists of a combination lever and ratchet design which assures both easy and rapid application and release of pressure on the unit equalizer.

Locomotive Boiler Questions and Answers

By George M. Davies

(This department is for the help of those who desire assistance on locomotive boiler problems. Inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless special permission is given to do so. Our readers in the boiler shop are invited to submit their problems for solution.)

Grooving of Girth Seams

Q.—What causes grooving along the girth seams of a locomotive boiler? Why is the grooving found only on the water side of the seam?—J. B. J.

A.—Grooving of girth seams is generally found along the lower portion of the shell at the inside caulking edge of the seam. It is caused by the uneven expansion and contraction of the boiler barrel resulting from the uneven stresses set up because the water in the bottom of the boiler has a lower temperature than the water and steam at the top. In other words, the length of the boiler along the top becomes greater than that along the bottom or belly of the boiler. This results in the boiler "humping" or raising at the center. Repeated actions of this sort weaken the metal at the edge of the girth seam along the bottom of the boiler. This area, being cooler, becomes a hinge point and segregation occurs in the plate. This, combined with the action of the water, causes the plate to deteriorate and grooving results.

The same condition of the plate also occurs along the outside caulking edge but, since there is no water action, deterioration of the plate does not develop to the same extent.

Welding Staybolt Holes

Q.—When repairing staybolt holes in firebox side sheets, is it satisfactory to weld, re-drill and tap new holes, or should sunflowers be used?—L. D. M.

A.—The general practice is to weld a hole only where the maximum oversize of staybolt has been reached and it is desired to reduce the hole in size to accommodate a staybolt of the original diameter. Sunflowers are used to repair side sheets which have cracks radiating from the staybolt holes. Sunflower plugs should not exceed 3¼ in. in diameter and the number used should be limited. A side sheet area requiring an excessive number of sunflowers should be renewed with a welded patch.

Welding Staybolt Sleeves

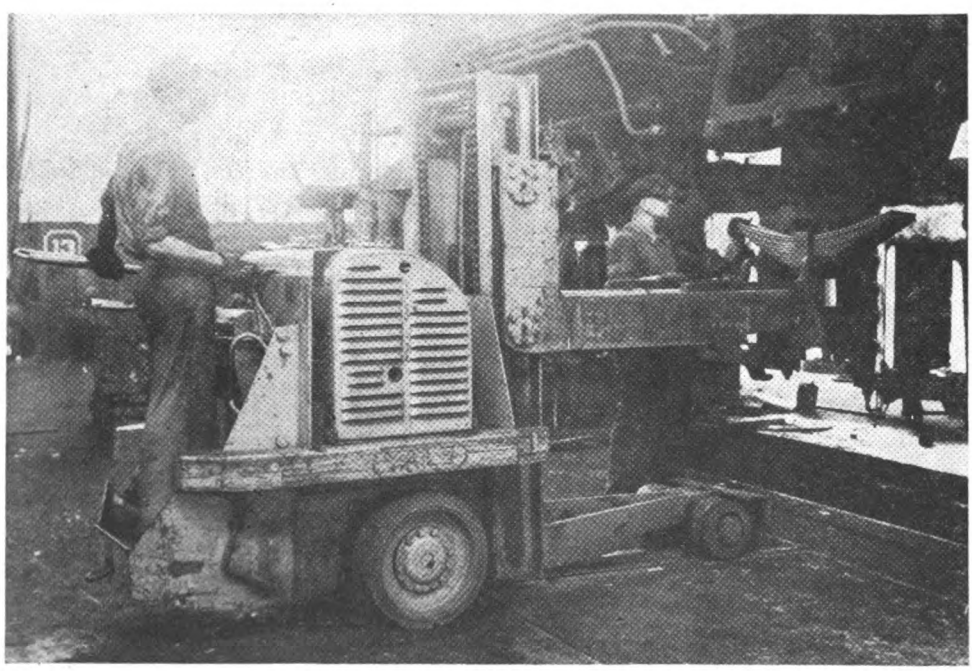
Q.—Should flexible staybolt sleeves be welded to the wrapper sheet in one or two passes of the electrode?—R. E. N.

A.—One pass should be sufficient because only a seal bond is needed between the sleeve and the sheet. Only sufficient metal to prevent leakage should be applied. The strength or security of the bolt and sleeve is self-contained and does not depend on the weld. Care should be taken to clean the sheet thoroughly of scale and foreign substances, including oil and grease. Sand blasting will be found to be the most effective as well as economical method. Quality of the weld deposit rather than quantity is most important when welding staybolt sleeves.

Applying Heavy Locomotive Springs

A quick and convenient method of applying heavy locomotive springs is now being used with exceptionally satisfactory results at the Decatur, Ill., shops of the Wabash, as shown in the illustration. The Yale lift-truck, which is widely used about the shop for many other operations, in this instance is equipped with a spring-lifting fork made in two sizes or types. The one illustrated is designed for use in applying driving springs to the spring saddles on the main locomotive frame. A similar fork, but with underslung carrying arms, is used to move and lift trailer springs and yokes into place.

Referring to the illustration, the lifting fork is made of two 1½-in. square steel bars, permanently connected by a welded cross piece and designed so that two 48-in. arms rest on the truck platform and have ends designed to hook into two 1⅝-in. holes drilled in this platform. The outer fork ends, 18 in. long, are offset upward 8 in. above the platform level and are spaced so as to support



Yale lift truck equipped with special lifting fork used in applying locomotive driving springs

ıe driving spring, up-turned lugs on the fork ends keep-ıg the spring from slipping off.

This lifting fork may be easily applied to or removed ·om the lift truck and is a definite labor-saving device. ormerly, from four to six men were required to hold ıe end of a long lift bar while the shop crane was being sed to insert driving springs in place on the locomotive ·ame.

For the application of heavy trailer springs and yokes, relatively low lift is required and the lifting fork used ›r this purpose is similar to the one described, being used ·ith equally satisfactory results and saving much time nd labor. In this instance, the fork arms on the lift ·uck platform are identical with the other design and ook into the same holes in the platform. The spring upport arms are also the same length but offset down-·ard 12 in. to permit inserting trailer springs and yokes t the required low level.

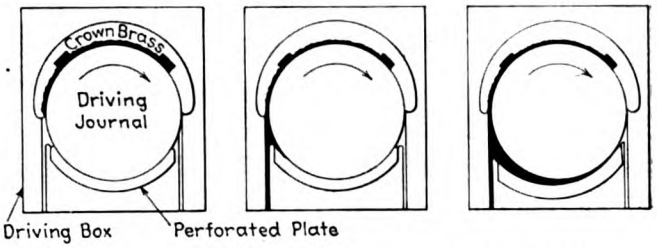
Grease Grooves in Driving Box Bearings*

By S. M. P.

t required about fifty years for us in the mechanical lepartment to become aware of the fact that oil, instead)f entering the bearing of an engine truck, pony or trailing ·uck from the oil hole in the top of the bearing, actually was being pumped out through the centrifugal pumping ıction of the journal. It would no doubt amaze us if we knew how many thousands of gallons of oil were pumped out of the cellars and wasted onto the ground, before we were willing to accept this as a fact and plug the holes to stop the waste.

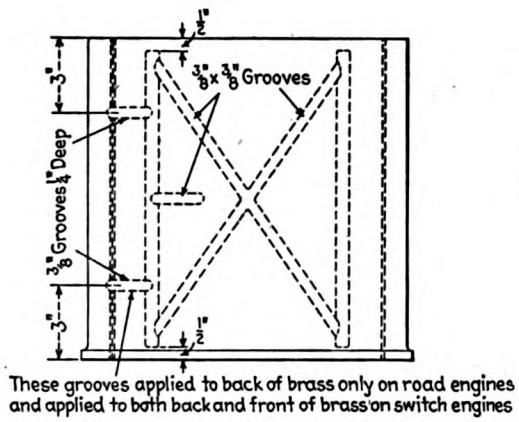
A similar situation exists today when most of our Class I railroads, as well as those who sell locomotive grease cellars, advocate and go to the expense of cutting grooves in driving-box bearings, believing that the grease feeds out of the cellars and enters these grooves, and through these grooves feeds to the journals to lubricate them. These grooves in the driving-box bearing are a means for the grease to get out of the cellar in a way similar to the oil pumping out of the top of an engine, trailer or pony truck bearing, except that the grease does not run like oil.

When bearings are tight and run cool there is a very slow movement of the grease. As the bearings wear and temperatures rise, the movement is more perceptible. The grease that adheres to the journal as it passes up under the bearing is subjected to from 335 to 395 lb. pressure per sq. in. Under pressure the grease will feed out wherever the pressure is relieved. Dowel plugs are sometimes found pressed out onto the top of a driving box. When this happens the cellar will empty itself out on top of the box. Sometimes grooves are lengthened to run out at the hub face of the box, and when this is done you will find that the cellar empties itself at the hub face. Any place where there is a leak in the bearing the grease will come out. Therefore, the grease grooves instead of being a means for letting the grease to the bearing, furnish a means of escape. This might not be so bad if the grease was simply lost but it fills the cavity between the side of the cellar and the driving box. When this is full the additional grease shoves the perforated plate away from the journal and a hot box results. The drawing shows this action as it takes place.



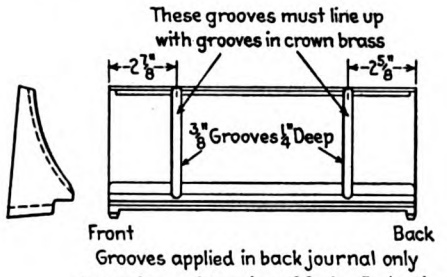
Grease from the grooves is forced between the box and the cellar and results in a hot box

* Operating about 850 locomotives, 21 per cent of which are oil lubricated, the writer's territory showed a record of one million two hundred and eighty thousand miles per hot driving box in the year 1944.



These grooves applied to back of brass only on road engines and applied to both back and front of brass on switch engines

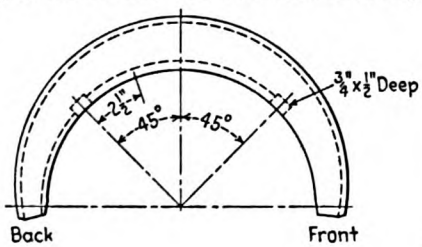
Typical railroad locomotive bearing

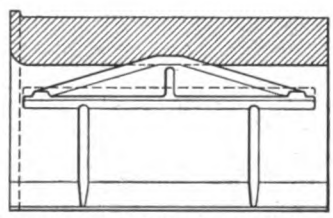


Grooves applied in back journal only

Lower journal bearing of 2nd & 3rd pairs of drivers of 4-10-2 type locomotive

Note:-
All grooves to be chipped in brass and edges slightly rounded





Brasses on main journals must be bored $\frac{1}{64}$" larger than journal. All other brasses to be bored $\frac{1}{32}$" larger than journal

With the Car Foremen and Inspectors

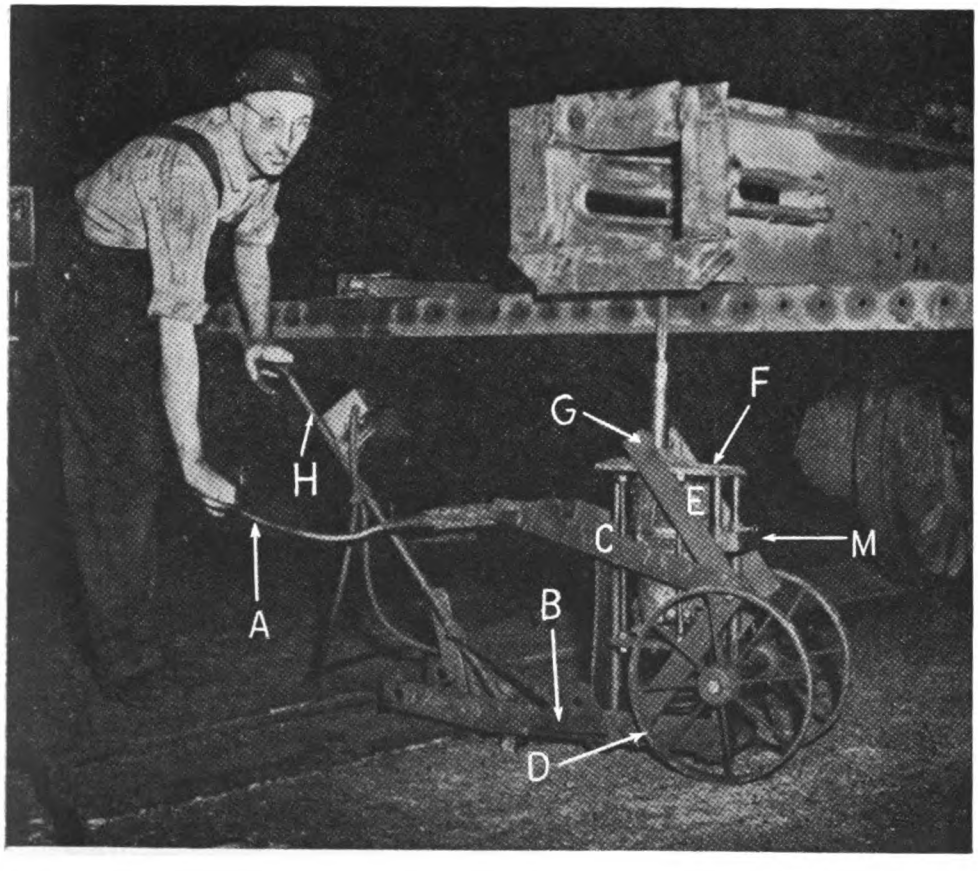
Device for Reaming Underframe

An ingenious portable two-wheel reamer buggy, developed at the Bessemer, Ala., plant of the Pullman-Standard Car Manufacturing Company, is shown in the illustration performing some upward reaming operations in a car underframe.

This device consists of reamer with the motor and gear-reduction drive mounted in a steel frame *F* equipped with corner posts telescoping slightly larger corner posts set in the main frame *M* of the machine which is designed with base *B* extending almost to the ground and handle *H* for moving the reamer buggy about the shop with the weight supported almost entirely on the two truck wheels. The electric motor is started and stopped by push-button control from a small control box conveniently located on handle *H*.

The vertically mounted reamer and reamer drive unit is raised and lowered on the telescoping rods by an ingenious lever arrangement which may be either hand or foot-operated. A single forged crank lever *CC* is hinged at *D* in the base of the machine and designed with an extension handle *A*. Straight lever *E* is hinged at *G* on the reamer unit and also pin-connected at the lower end to the knee of crank lever *CC* in such a way that downward pressure on handle *A* gradually raises the reamer-drive unit

Foot pressure is used on the operating handle to finish the reamed hole



General view of electrically-operated two-wheel reamer buggy used for reaming holes in car underframes

ıd reamer with rapidly increasing pressure as the lever-
ge angle approaches 180 deg.

In operation, this reamer buggy is easily moved by one
ıan into position under the car center sill or frame which
to be reamed and the electrical connection made. Using
andle *H* to make slight necessary adjustments of the
ıggy position, handle *A* is pushed down by hand until
ıe reamer enters the hole which is to be reamed. Fur-
ıer hand pressure downward starts the reaming opera-
on and by that time handle *A* is fairly near the floor and,
desired, the heavy finish reaming may be done by foot
ressure on handle *A*, as shown in the second illustration.
aising handle *A* withdraws the reamer from the hole.

Ample power is available in this machine to ream up to
⅝-in. holes which is large enough for by far the great
ıajority of rivet holes in car underframes. In case heav-
er reaming is required, however, a larger electric motor
ır more powerful gear reduction unit would be required.
The use of this light, flexible and powerful machine elim-
nates all upward hand reaming under the car.

Markham Wheel Shop On the Illinois Central*

By F. J. Holsinger†

All scrap wheels received at the Markham, Ill., wheel shop of the Illinois Central are put on a standard double-wheel track where they are inspected and marked as to whether they are scrap or second hand. This track leads directly to a stripping press where the wheels are dismounted, the scrap wheels going into an automatic lift that conveys them to a chute 150 ft. long with 10 grates, making it possible to separate steel wheels from cast-iron wheels. These wheels are loaded into cars by a magnet crane to be returned to foundries. This method eliminates hazardous handling by hand.

An axle conveyor that works on the same principle as the wheel chute is used to separate the surplus second-hand axles into rows of different sizes and to discard the scrap axles. The second-hand axles are carried from the stripping press by an electric hoist crane to the axle-lathe bench which will hold 12 axles with enough room on both sides for inspection and the drilling of center holes when necessary. We have a portable clamp that fastens back of the collars with which we use a combination countersink and drill for making the lead holes for recentering.

All axle lathes are equipped with gauges for checking journal length and diameter. The shoulder is cut back for inspection of the wheel seat and for measuring the radius of the fillet. The lathes are equipped with tool-post turrets and permanent tool holders, making it necessary to remove only the tool bits for sharpening. Most of the lathes are equipped with live centers, and those that are not are coated with Stellite. The practice at Markham is to turn all wheel seats, journals and end collars. The wheel seats are turned the same size on the individual axles so as not to confuse the man on the boring mill who handles the micrometer.

All axles are checked for seams and cracks before they are placed on a rack to be moved to the burnishing machine. All center holes are ground on the surface with a portable grinder to remove burrs and roughness before the axles are put into the burnishing machine to have the journals rolled. After this they are again checked for seams or cracks and measurements are taken. Upon removal from the burnishing machine, they are placed on tracks leading to the wheel press to have the wheels mounted.

All new wheels are hauled to the boring mills with a self-loading and unloading truck especially built for this purpose which will haul wheels up to 40 in. in diameter. This truck is easy to manipulate and does away with the hazardous practice of rolling wheels by hand and overcomes the problem of man-power shortage in this particular phase of the work.

The boring mills are checked every Monday morning with a dial gauge and are ground true with a portable grinder fastened to a Davis bar. We find the grinding necessary about twice a year when other repairs are made to jaws. After the jaws have been ground, a pair of wheels is bored, mounted and tested in a gap lathe equipped with live centers to see if the wheel is perfectly true. All wheels are bored within the limits of the A.A.R. specifications and micrometer measurements are marked on wheels and axles to correspond.

The wheels are rolled to the mounting press by press operators who apply a coating made up of pure white lead and linseed oil. The proper mixture of this coating is a very important factor in wheel mounting, as a wrong mixture can cause a good many misfits. We use 12 lb. of white lead to one gallon of boiled linseed oil, as instructed in the manual. This mixture should be tested daily with a heavy liquid hydrometer and made fresh at least once a week as it thickens and, when thick, it will make changes in the wheel pressure.

All gauges used at the mounting press are checked each Monday morning with master gauges and when they are found to be out of gauge, they are built-up with Stellite. An extra recording gauge is kept on hand to be used in case of emergency, and for making repairs needed to the one in use. As each pair of wheels is mounted, the wheel numbers, date cast, capacity and initials of the mechanic boring the wheels are shown on the recording chart in case any checking back is necessary.

The axles are centered by a marker gauge with a dull point so that the center of the axle will not be defaced and, possibly, cause a progressive fracture. We have a separate solid gauge for each class of axle. Guards are put on the journals before the wheels are placed on the axle; they are then rolled into the press where both wheels are pressed on without turning the axle. The axle is pressed into the first wheel and the second wheel is pressed on the axle. After this they are gauged at three points with an overall gauge. The journals are greased and the wheels leave the shop on a standard wheel track for loading by a locomotive crane; or, they can be turned on an air jack in the center of the track and rolled back into the shop to be ground and tested for roundness.

Our wheel press is operated with oil in place of water. We find this much better as it lubricates the valves, keeps the leathers soft and protects the plunger sleeves.

For stripping motor-car wheels, Spicer drives, and other special wheels with gears on axles, we have a jib crane and a monorail with a suspended hoist to handle heavy tools. With this equipment a mounting press can be changed over to serve as a stripping press. This is very helpful as many wheels cannot be dismounted on the regular stripping press.

We are able to reclaim a great many cast-iron wheels that have slid-flat spots by putting them in a Norton grinder. We also grind cast-iron wheels for application to cabooses. All steel wheels for streamlined trains are put through this grinder and balanced.

* An abstract of a paper delivered before the Southern & Southwestern Railway Club at Atlanta, Ga., on September 20, 1945.

† Wheel shop foreman.

New axles are used for passenger service when they are available. When second-hand axles with new dimensions are used they must be tested for cracks with a magnetic testing machine. Wheels with cut or discolored journals must also be so tested. It is my opinion that all wheel shops should be equipped with this equipment and have all axles, both for freight and passenger use, pass through the machine before the wheels are mounted. There are cracks that cannot be detected by ordinary inspection.

In checking axles on Diesel switching engines we found that 59 out of 60 were cracked. The cracks were between the gears and wheel fit; some of them were all the way around the axle and as deep as three inches. This type of axle has been redesigned by doing away with the fillet and cutting a straight taper about ¾ in. in length, equally divided between the gear and the wheel. Later Diesel axles are purchased with the gear dovetailed to overcome the defect. We also have found cracks in our streamlined locomotive axles, but no cracks have been found in the streamlined car axles that have been tested magnetically.

Nearly all steel wheels are bored by one boring mill which is equipped with a large Davis bar. This eliminates chatter by using shorter tools, and works out very satisfactorily in boring wheels of the larger sizes up to 9 in. bore. All coach wheels are turned in a lathe and are taped for size after the wheels are finished; we do not depend on the measuring attachment on the lathe as we bore. All coach wheels are turned in a lathe and are tapes, and it has been proved that if a wheel is out one tape, the smaller wheel must travel 9½ ft. further for each mile. This causes sharp flanges and, in my opinion, also contributes much to hot bearings. All wheels are then placed in a gap lathe for turning the journals and the wheels are tested for concentricity.

A number of wheels have been found with the treads turned that were as much as ⅛-in. eccentric although they were the right tape size. This condition is caused by the material in the wheels being harder in some spots, which is mostly caused by slid-flat spots. These wheels are placed in the grinder and ground true before they are put out for service. Tool holders are made from tire steel and a pin insert tool is used for rough turning which has greatly reduced cutting-tool cost.

All wheels for streamlined trains mounted in our shop are balanced and ground but not turned, as this is done in the Diesel shop where we have a later type machine and the turning can be done without removing the bearings.

Hot Journal Costs

[The following abstract is taken from a paper delivered last year before the Eastern Car Foreman's Association by P. J. Hogan, supervisor of car inspection and maintenance, New York, New Haven & Hartford. We will be glad to publish similar studies which any of our readers may have made.—EDITOR.]

It is a difficult task to tabulate accurately the actual cost of a hot box as each hot box occurs under different circumstances. Factors which must be considered are: the class of engine or train involved; number of cars and tonnage; type and style of trucks; wheels, whether chilled-iron or steel; location of set-out, which determines operating delays; proximity of nearest repair point; back haul required, if any; nature of repairs made; the condition of wheels after removal; condition of journals after removal; and, the disposition made of wheels removed. Additional costs may result from loss through claims for damage to ladings or spoiling of perishable freight. Market losses may be incurred because of delayed train arrivals. Car equipment and roadway damage may result and personal injury costs may need to be considered. All of these factors tend to vary costs in any single case.

In order to estimate the costs of a hot box, a typical journal-failure situation will be considered. The figures will be arbitrary, but we will try to keep them within reasonable limits. As an example let us consider a modern steel box car, equipped with 5½-in. by 10-in. Bettendorf-type trucks and chilled-iron wheels, set out of a 100-car train 20 miles from the nearest repair point because of a cut journal. The assumed delay is one hour which includes switching out the defective car and waiting for clearance from the dispatcher. We shall try to estimate the cost involved from the time the car was set out until it is again placed in train service ready for departure to its destination.

The costs on wheels do not include axles and if the axle removed was scrap it would change each estimate.

Such a car before reaching its destination may be back-

Direct Costs Involved In Setting Out a Car for a Hot Journal

Setting Out Car Enroute

Fuel—½ ton coal used during 1 hr. delay at $5.42 a ton	$2.71
Brake shoe wear assuming 1/32 in. combined wear per car	2.44
Crew time not estimated (crew is paid on a miles and hours basis in through freight service and a 1 hr. delay would seldom result in any increase in wages)	
Cost	$5.15

Road Service By Car Department

Motor truck, 40 miles round trip at 10 cents per mile	$4.00
Labor—2 hrs. at $1.60 (A.A.R. rate)	3.20
Oil, waste and coolants	.30
Second-hand brass usually used to get car to repair point	
Cost	$7.50

Picking Up Car for Movement to Repair Point

This is usually done by engine and crew in local freight service. As 8 hrs. constitutes a day for the crew the time consumed in picking up car would be part of that 8 hrs. or any overtime. Engine fuel and crew labor	$7.5
Cost	$7.59

Yard Switching at Repair Point

Placing car on repair track by switcher	$1.08
Removing car from repair track by switcher	1.08
Cost	$2.16

Repairs on Repair Track

Second-hand cast-iron wheels R. & R. (material)	$
Two new 5½-in. by 10-in. bearings less scrap credit	2.53
Two new dustguards and plugs	.12
Waste and oil	.5
Jacking car	1.6
Usual possibility of additional per diem charge	$1.0
Labor on wheels—Includes pressing wheels off and on, boring wheels, handling, all machine shop labor on new or second-hand axles, and removing and replacing wheels in truck as per A.A.R. rates, 4 hrs. at $1.60	6.4
Cost	$12.12
Hot box cost, example 1	$34.4

Variables Affecting Costs

When second-hand wheels removed are scrap:	
1 pair second-hand wheels applied less scrap credit	$6.7
Plus hot box cost, example 1	34.4
Hot box cost, example 2	$41.1
When new wheels are used in place of second-hand wheels:	
1 pair new wheels less credit for second-hand wheels removed	$15.4
Plus hot box cost, example 1	34.4
Hot box cost, example 3	$49.8
When new wheels are used and wheels removed are scrap:	
1 pair new wheels less scrap credit	$22.1
Plus hot box cost, example 1	34.4
Hot box cost, example 4	$56.5

The average cost of these four examples amounts to $45.48.

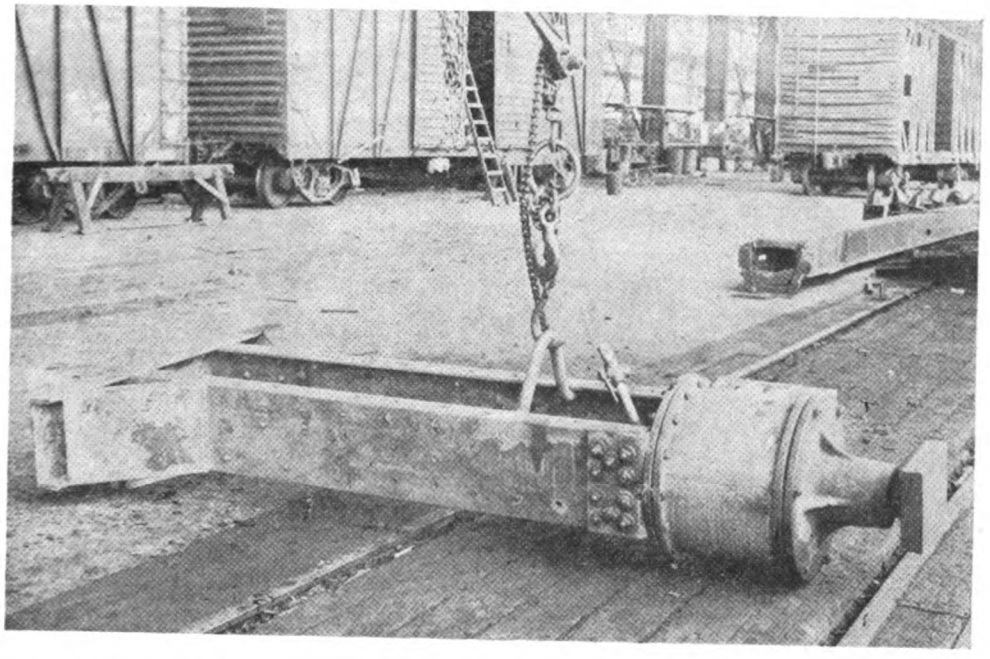
auled an additional 40 miles because of journal failure nd, therefore, the cost of hauling this extra tonnage hould be added to the estimates.

This report is not intended to estimate the cost of an verage hot box but is an example of a typical journal ailure.

Car-Side Straightener

Among other types of coal-carrying cars, hopper cars re subject to damage when the lading freezes in temeratures below 32 deg. F. and the car side panels are attered and hammered in an effort to unload the coal. The device shown in the illustration has been designed nd constructed at the Decatur, Ill., car shop of the Vabash for the specific purpose of pressing these sideanel sheets outward and straightening them again without removing the sheets and usually without even heating them.

The device consists of a well-braced steel post and ooting, made of 12-in. channel sections and equipped t one end with an 18-in. by 12-in. passenger air-brake



Channel-section steel post and air cylinder used in straightening dented hopper car side sheets at the Decatur steel car shop

ylinder having a 2¼-in. by 9-in. by 12-in. draft-gear ollower plate welded to the end of the piston. The ase of this press is 51 in. long, or more than enough o reach across two side posts of the hopper car. Diagonal braces which are welded to the base for stiffening urposes are 18 in. long. The total length of the carside straightening press, exclusive of the air-brake cylnder, is 6 ft. 6 in.

The pressure head of the air-brake cylinder was reoved and a ¾-in. steel head substituted which is bolted o two angle brackets attached to the main frame. A ¼-in. air pipe connection is made to the pressure head f the air-cylinder, the three-way cock, illustrated, being sed to admit air to the cylinder as required or exhaust t. A ¼-in. round hanger loop is welded to the device ear the center of gravity so that it can be supported rom the crane hook. It can then be balanced in a fairly orizontal position when used in the straightening of car sides.

Air Brake Questions and Answers

HSC Equipment on Passenger Cars and Diesel A and B Locomotive Units Brake Application

EMERGENCY APPLICATION (*Continued*)

317—*Q.—What pressure is obtained?* A.—This provides a maximum pressure of 75 lb. However in this handle position emergency valve *10* and its pilot valve *12* are unseated by a cam on the brake valve handle shaft, allowing air from passage *1* and the brake pipe to escape rapidly from passage *1b* to exhaust (*EX*). This provides emergency rate of brake pipe reduction that is transmitted serially to each control valve in the train, operating the emergency portions of the control valves to produce an emergency brake cylinder pressure of approximately 98 lb.

318—*Q.—What movement is effected at the D-22-ER control valve as the result of an emergency rate of reduction?* A.—Referring to Fig. 26, the emergency rate of reduction reduces the pressure in chamber *B*, on the face of the emergency piston.

319—*Q.—The emergency piston moves forward after this reduction. What brings this about?* A.—As quick action chamber pressure on the opposite face of the emergency piston cannot escape through the vent port *t* in emergency graduating valve *30* and port *y* in the slide valve to atmosphere at the same rate, sufficient differential is built up across the emergency piston to compress spring *49* and allow the graduating valve *30* to move far enough on the slide valve to open port *t1* in the slide valve which registers with port *t2* in the seat, allowing quick-action chamber air to flow to the face of vent valve piston *42*.

320—*Q.—What action occurs after the resulting movement of this piston?* A.—Movement of the vent-valve piston unseats vent valve *40*, opening a large and direct passage from brake-pipe passage *1b* to the atmosphere.

321—*Q.—What does the venting of brake-pipe pressure past the vent valve insure?* A.—Insures the prompt movement of the D22-BR control valves on the cars to emergency position due to the serial emergency rate of reduction through the train.

322—*Q.—Describe the continued movement in the control valves brought about by the rapid reduction of brake pipe.* A.—The emergency piston and slide valve move to the extreme right, which carries slide-valve port *t1* out of register with port *t2*, but port *t2* is now uncovered by the tail port in the slide valve so that quick-action chamber pressure remains connected to the vent-valve piston.

323—*Q.—What additional pressure enters into the picture to assist in producing a higher-brake cylinder pressure?* A.—Emergency reservoir.

324—*Q.—How is this brought about?* A.—The emergency slide valve now connects the spring side of the high-pressure valve *44* to the exhaust *Ex*, through passage *h1* and cavity *h2* in the slide valve *29*. This vents air pressure from the spring side of the high-pressure valve, and emergency reservoir air in passage *2*, acting on the outer area of the valve, unseats this valve, permitting emergency reservoir air to flow through passages *3h* and *3f* and eventually to the master controller.

325—*Q.—Through what valve must the emergency-reservoir air pass before reaching the master controller?* A.—The No. 15C double check valve Fig. *32*.

326—*Q.—How is this accomplished?* A.—With the emergency slide valve in emergency position, the air from passage *3f* flows through slide-valve cavity *S* to passage *15*, pipe *15* and the *No. 15c* double check valve. As the emergency reservoir pressure is higher than the control pipe pressure on the face of check valve *4* in the double check valve, developed by the self lapping unit of the brake valve, the higher pressure moves check valve *4* to its opposite seat and flows to the master controller.

327—*Q.—How is the master controller thereby operated?* A.—As described for the HSC brake application, to develop an equivalent pressure in the straight-air pipe on the locomotive and cars and therefore, in the relay pipe *16*.

328—*Q.—How are the FS-1864 and F-1864 relay valves then operated?* A.—To produce the adjusted ratio of brake-cylinder pressure as regulated by the speed governor. In this manner a higher brake-cylinder pressure is obtained throughout the train in emergency application than in service.

329—*Q.—What happens in the event of interrupted circuits, etc.?* A.—In the event that interrupted circuits prevent the high emergency braking pressure from developing normally, the secondary automatic brake system will function to do so.

330—*Q.—What combination of pressures brings about the development of a higher pressure in emergency than is obtained from either the electro-pneumatic or automatic pneumatic service brake application?* A.—The pressures in the emergency and auxiliary reservoirs equalize passage *3* into the displacement reservoir.

331—*Q.—How is this brought about?* A.—At the D-22-ER control valve, the emergency-reservoir air in passage *3h* flows to passage *3b*, *3a* and *3* to the displacement reservoir. Meanwhile the emergency rate of reduction in brake-pipe pressure has caused the service piston and slide valve to move to the extreme left where the graduating valve uncovers the service port *f*, through which auxiliary-reservoir air from chamber *C* flows into passage *3b* and to the displacement reservoir passage *3*, combining with the flow from the emergency reservoir.

332—*Q.—To what valve is the displacement reservoir connected?* A.—To the relay valve.

333—*Q.—Trace the air between the relay valve end and the displacement reservoir.* A.—Displacement-reservoir air flows through passage *3* to the bottom face of double check valve *263* in the application and release portion. The check valve is moved to its upper seat, connecting passage *3* to passage *16c* and *16*, through which the higher pressure builds up in the *16* pipe to the relay valve.

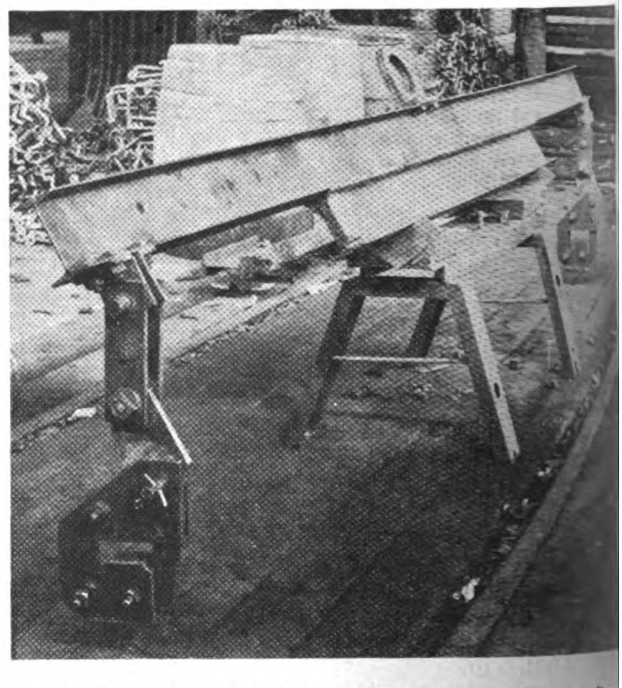
334—*Q.—How does the relay valve then function?* A.—It then operates to develop the adjusted ratio of brake-cylinder pressure controlled by the speed governor, as described under HSC brake application.

Operation of the Independent Brake Valve

335—*Q.—Describe the position of the various operating parts of the independent brake valve in release position.* A.—The cam on the independent-brake-valve shaft *11* engages pusher *68* attached to floating levers *67*. In release position of the brake-valve handle the cam is at its lowest position so that the balance levers float freely and inlet spring *51* holds inlet valve *50* seated, and spring *63* unseats exhaust valve *64*, opening the brake-valve cavity *B* to the brake-valve exhaust *Ex*. Poppet valve *25* is held unseated by dog *15*, controlled from the cam of the brake-valve shaft, thereby opening the independent application and release pipe *20* into the brake-valve central cavity *B*, and thence past the exhaust valve *64* to the brake-valve exhaust. Spring *22* holds valve *21a* unseated, opening the actuating pipe to the atmosphere.

Car-Side Riveting Position

The Wabash is currently engaged in a program of constructing 50-ton gondolas at the company car shops, Decatur, Ill., and the accompanying illustrations show an arrangement for riveting at the position where car sides are assembled.



Special hitch used in handling car side with the overhead traveling crane at Decatur shops

This shop is equipped with the usual long pit and fixed riveting machine, but the pit is not deep enough to permit riveting high gondola car sides without inverting them while pressing the various courses of rivets and, moreover, the riveting pit and shop crane required for its oper

ation are more or less busy. To meet this condition a riveting position with special equipment was installed, as shown in the illustrations.

The first thing noticeable in connection with this job is that the car side rests under a monorail on the shop floor, being steadied in a vertical position by a brace at either end, bolted to one of the shop building posts. All riveting of top rail, floor rail, bottom rail and side stakes to the sheets is, therefore, done with the riveting crew standing on the shop floor. The Chicago-Pneumatic riveting machine, with a capacity to drive up to 7/8-in. rivets, is suspended from an Ingersoll-Rand 1,000-lb. air-motor hoist and trolley which traverse a 6-in. I-beam, securely supported over the riveting position.

Referring to the combined illustration, the right view clearly shows this pneumatic riveter as suspended from the air hoist and trolley. The center view shows the entire riveting position, featured by location of oil-fired rivet heater *R* on a platform seven feet above the shop floor and about central with the position of car side *S*. Two elevated hoppers *HH* are located, one on either side of the rivet heater, and, each has the side towards the heater cut away so that hot rivets can be easily tossed into the hopper and delivered through a telescoping sheet metal pipe directly to the point where they are being used regardless of position along the car side. The left view gives a close-up of the pneumatic riveter and one of the rivet delivery pipes which is designed with an open collector box on the bottom resting on a small steel table 8 in. high for convenience in picking up rivets. The cushion the fall of the rivets and prevent them from overheating the box.

A few additional details may be of interest. The rivet heater platform is 6 ft. wide by 8 ft. long, or large enough to support the heater and give extra floor space for the operator and a keg of rivets elevated to that position by another air hoist. The rivet hoppers, made of galvanized steel, 40 in. in diameter, are supported by light 3-in. and 4-in. angle iron brackets bolted to adjoining building columns. The upper section of the rivet delivery pipe is 3 in. in diameter and connected through a Barco flexible metallic joint to the cone of the hopper. The lower section, 3½ in. in diameter, telescopes the upper part and is equipped with a collector box at the bottom, as described. Each of the two rivet-delivery pipes may be easily swung and extended to cover one-half of the car side.

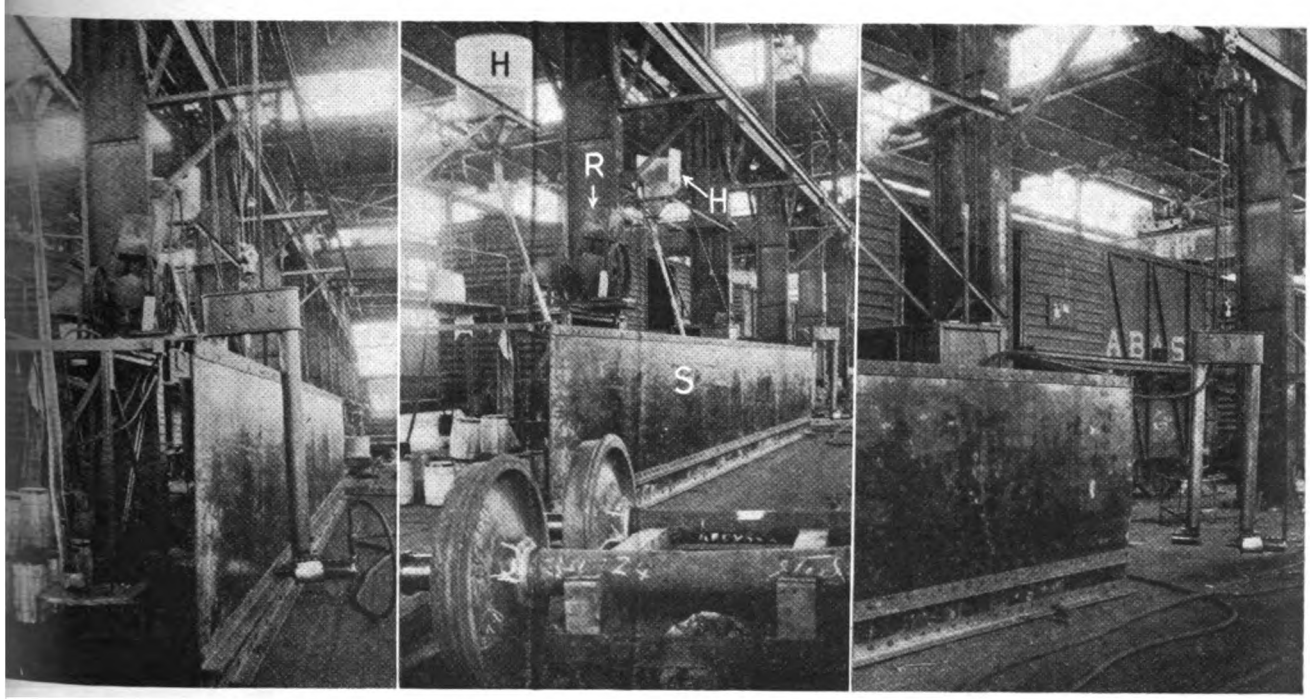
In assembling the gondola car side, illustrated, there are three rows of rivets, namely in the top rail, floor rail and bottom rail. This requires a total of 394 5/8-in. rivets per car side. These rivets can be driven with minimum delay, using the riveting arrangement and particularly the improved rivet-delivery system and equipment which have been adopted.

Car-Side Lifting Device

A device which assists materially in handling relatively flexible hopper car sides with the overhead crane at Decatur shops is shown in a separate illustration. This consists of a 6-in. I-beam, 16 ft. long, reinforced at the center with a shorter 6-ft. section welded in place for stiffening purposes. A ring connection to the crane hook is also made at the center.

At each end of the beam is a pair of links and built-up, double-plate jaw, pin connected to the links and designed to fit and be applied around the bulb angle on the car side. This double-plate jaw is made of ¾-in. thick steel plates and is roughly 9 in. wide by 12 in. high. The double plates are spaced far enough apart to accommodate a single central lifting plate, and short through bolts and nuts hold the three plates together.

The fit of the jaw around the bulb angle is such that the jaw can hardly slip off when lifting a car side at any angle, but, as an added precaution, the open side of the jaw is covered with a steel guard finger which extends down from the central lifting plate. An upward pull tends to keep the guard finger in place, but a positive lock is provided by insertion of a pin through the three plates. This pin may be easily removed when the car side has been lowered in place and it is desired to remove the crane hitch and lifting jaws.



ar-side riveting position at Decatur shops—Right: Chicago-Pneumatic riveter suspended from mon-rail by I-R pneumatic hoist—Center: Rivet-g position showing rivet heater *R*, rivet hoppers *HH* and two rivet delivery pipes—Left: The riveter and one of the rivet-delivery pipes ready for operation

Revised Distribution System

Chesapeake & Ohio improvements save both power and material and avoid flood hazards

BY RAISING line voltage, redesigning the substation and simplifying the distribution system at Stevens, Ky., the Chesapeake & Ohio has reclaimed copper, reduced power losses, improved regulation and protected its equipment from floodwater. An additional saving in power is affected by limiting load demand. At this point power is purchased from a utility company at 13,200 volts, 3-phase, 60 cycles, through one meter, and is used to supply both the railroad shop and terminal facilities and residences, stores, etc., in the town of Silver Grove, Ky.

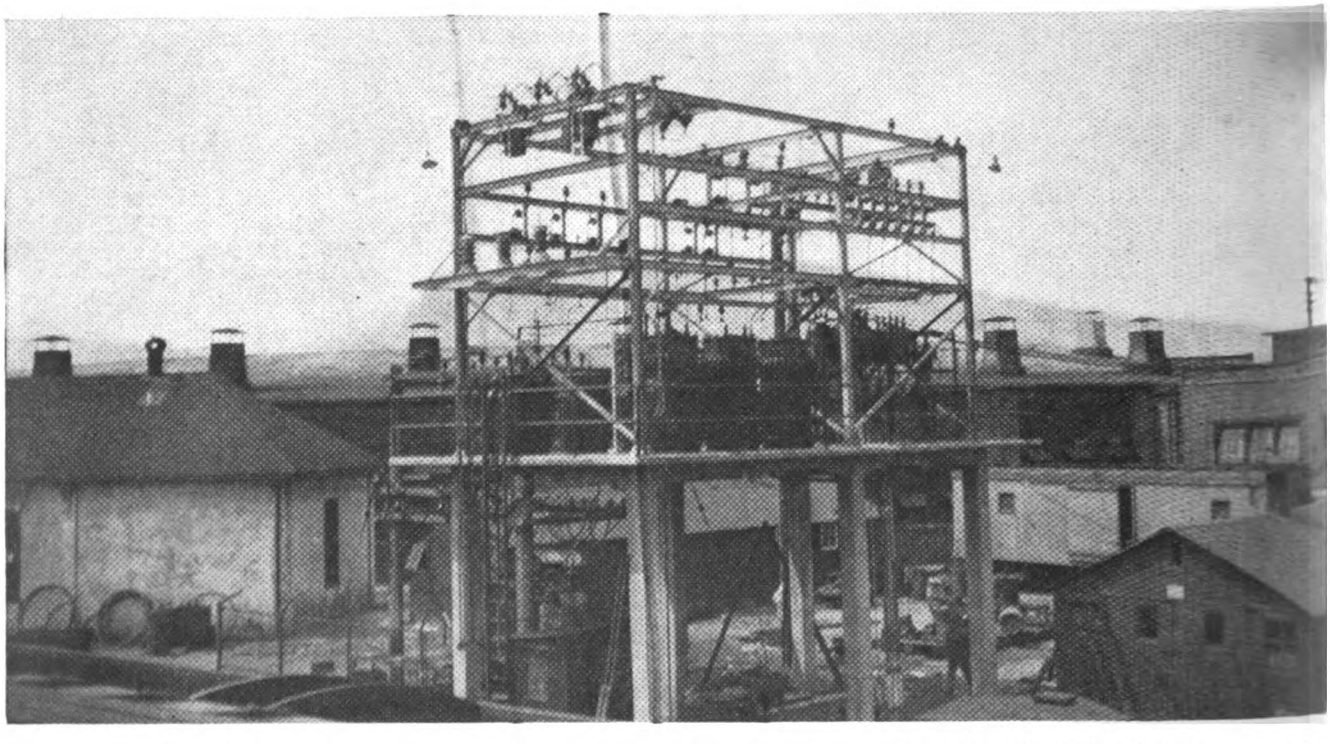
The original transformer equipment consisted of three 333-kva., 13,200- to 440-volt transformers located near the power house at the shops, with heavy cable connections to a switchboard in the power house. From the switchboard, power was distributed over several 440-volt circuits to the various shop facilities near the power house, as well as to several facilities remote from the power house, such as the water pumping plant, floodlights on the transportation yard, lighting in various yard buildings and the town of Silver Grove.

Lighting for the shops was supplied from the 440-volt mains through three 15-kva., 440- to 110/220-volt transformers connected in parallel. Lighting for other facilities was supplied from the 440-volt lines through a number of small transformers suitably located.

Some of the 440-volt lines supplying facilities remote from the power house were of great length and of large size copper. In the case of the line supplying the pumping plant, the distance was so great (approximately 6,500 ft.) that trouble with low voltage led to the necessity of raising the line voltage. Also, increased load in the town of Silver Grove caused overloading of the 440-volt distribution lines and transformers along the streets, making it necessary to take corrective measures.

Old Conditions Required Double Transformation

Conditions at that time made it impossible to go to the expense of revamping the main transformer substation; therefore, it was necessary to provide a bank of step-up transformers, consisting of three second-hand 75-kva. transformers, 440 to 2,300 volts; to convert the lines to the pump house and town of Silver Grove for 2,300-volt operation; and to provide suitable step-down transform-

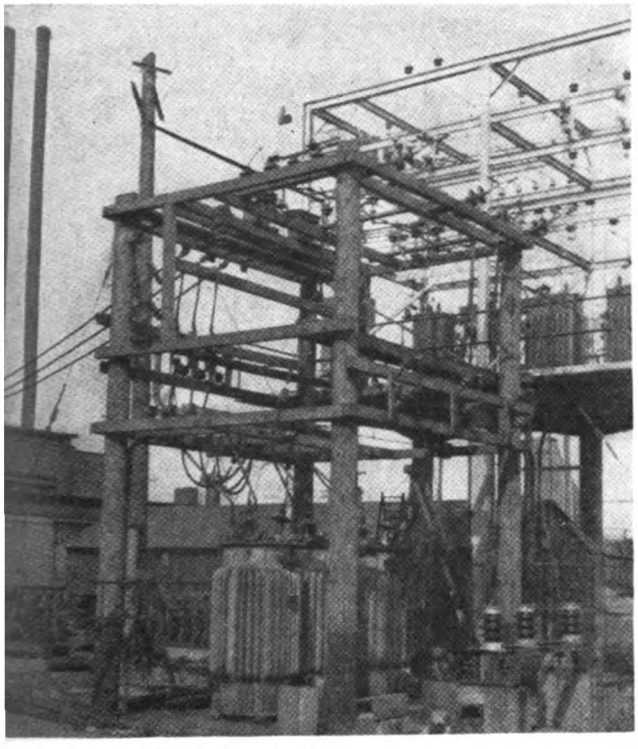


The new substation at Stevens, Ky. is mounted on an elevated platform 17 ft. above the ground and above the highest floodwater on record—No protective fencing is required

rs at the pump house and throughout the town. Under nis condition it will be noted that it was necessary to ransform from 13,200 to 440 volts, transform a second ime from 440 to 2,300 volts, and finally transform from ,300 to the final operating voltage.

The inefficient arrangement outlined above continued n operation for a number of years. A system-wide power tudy and efficiency program, which included an investiation of the conditions at Stevens, resulted in an appropriation to cover new transformers, substation equipment nd other apparatus required to provide a more efficient nd satisfactory arrangement.

Design of the new electrical layout incorporated the reuction of excessive transformer capacity; the supply of hop and remote facilities through separate transformer



The old substation with new one shown in the background

anks; the conversion of 440-volt lines to 2,400 volts for upply of remote facilities; the elimination of retransforation where practicable; and a general simplification of he power distribution system.

Timber Structure Replaced With Steel

A new steel substation structure was erected in place f an old timber structure that was in very bad condition. n the old substation arrangement, the three 333-kva. ransformers were mounted at ground level and were ompletely immersed during the 1937 Ohio River flood, ie water at the location of the substation being approxiately 17 ft. deep at flood crest. In order to avoid posble damage from future floods, the new steel substation ructure, transformers, etc., were mounted on a reinrced concrete platform, the top of this platform being 7 ft. above ground level.

The transformers used at the new substation are three 50-kva., 13,200- to 480-volt supplying power for shops nd nearby facilities; three 100-kva., 13,200- to 2,400-olt transformers supplying remote facilities and the town of Silver Grove; and one 50-kva., 13,200- to 120/240-volt supplying shop lighting.

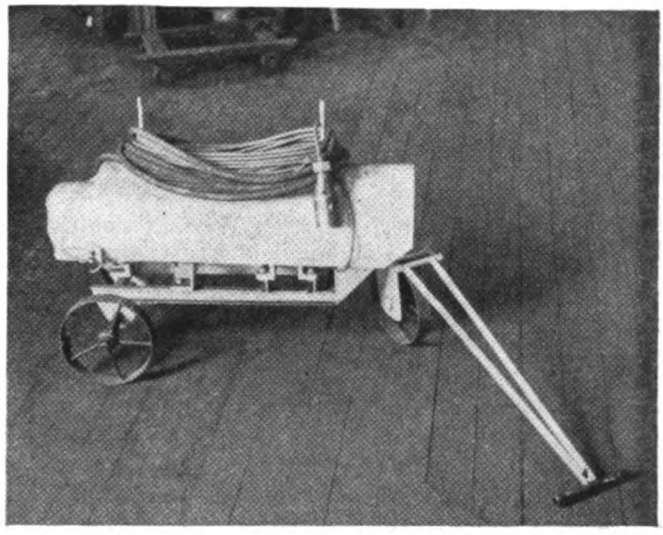
Two oil circuit breakers were installed at the substation, one for the 2,400-volt circuit to the town of Silver Grove and one for the 2,400-volt circuit supplying other remotely located facilities. Power and lighting facilities not located near the shops are now supplied from a 2,400-volt line through suitable transformers. This arrangement permitted the installation of relatively small size copper and the removal for other use of a large quantity of heavy copper cables, formerly used in the 440-volt distribution lines.

Also incorporated in the substation apparatus is a demand limiting device, which automatically disconnects a 75-hp. water-pump motor from the line during short intervals when the demand reaches the maximum specified in the power contract, thus avoiding penalties for excessive demand.

The original three 333-kva. main transformers, three 75-kva. step-up transformers and several other transformers that did not fit into the new arrangement were removed. An aerial ground wire was also supplied to all overhead lines for better protection from lightning.

Locomotive Circuit Tester

The truck-mounted, motor-generator set shown in the illustration was designed and built by electrical workers in the Omaha, Neb., shops of the Union Pacific. It is used in the erecting shop to supply 32-volt d.c. power to locomotives in the shop which are not under steam or are without headlight generators. With power supplied from this set, all necessary tests can be made on circuits,



Portable motor generator set for supplying 32-volt, d.c. power to locomotives in the erecting shop

headlights, cab and marker lights, cab-signal and train-communication equipment.

The set consists of a 440-volt, three-phase, a.c. motor, direct-connected to a Pyle National, Type M06 generator. It is operated from the shop power outlets which are used for welders and other portable machinery. The three-wheel mounting of the set makes it easily portable and the drip-proof cover protects the set from liquids and mechanical damage.

Fluorescent Lighting for Cars

By William W. Garstang *

A discussion of the relative merits of power supply systems using vibrating type boosters and inverters

IT IS now possible to obtain lighting systems which will enhance the beauty of railway cars and also give passengers more light without increasing battery load. Fluorescent lamps have made a significant contribution toward better lighting, but difficulties have been encountered in taking advantage of these benefits, most of them arising from the conversion of the electrical current. During the war, however, new devices have been developed which simplify railroad installations. The situation has been further improved by the introduction of new types of fluorescent lamps. They can now be obtained in lengths as great as 96 in. (8 ft.) with instantaneous starting. Another recent development is the circular lamp, opening up new types of applications.

An example of fluorescent coach lighting on the New York Central

Conversion systems may be divided into four types:

1—The voltage doubler, which steps up 32 d.c. to 64 d.c. volts, from which (twenty) 14-watt fluorescent lamps may be operated and individually controlled.

2—A special system designed to operate the new 93-in. cold-cathode lamps. This is the simplest, electrically, of the four, and is capable of changing any input d.c. voltage to a.c.

3—A system similar to No. 2, except that recently-developed "slimline" lamps are operated in series. These are "thin" lamps ranging in diameter from ¾ to 1 in. and in length from 42 to 96 in. They are operated without starters, and offer the same instant-starting feature as do cold-cathode lamps. Operating them in series simplifies the wiring system, and through special switches, individual lamp control is possible.

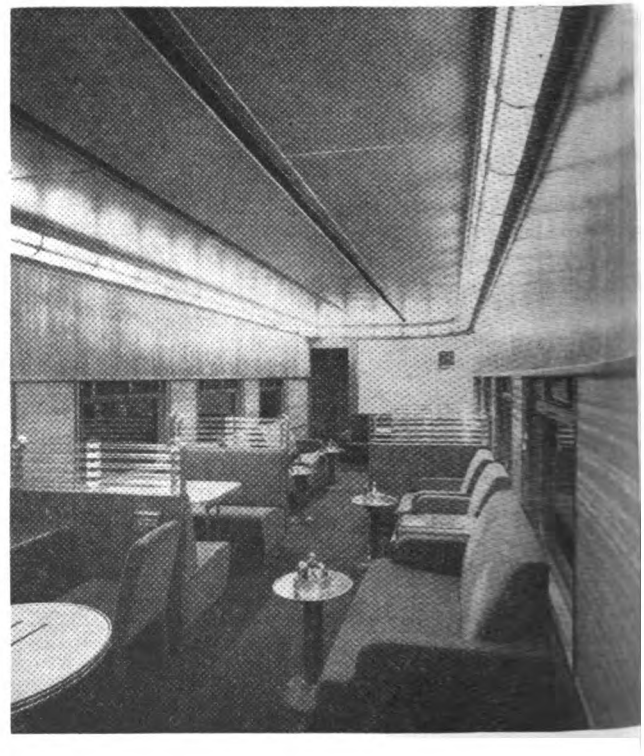
4—An arrangement for changing low d.c. voltage to a.c. for operating 30-watt lamps in parallel.

Each system has its advantages, depending on the economics of the particular application, passenger preferences, and the type of electrical installation.

The voltage doubler, which offers very high efficiency with individual lamp control, shows perhaps the greatest promise for railway coach use. The 15-in. length of the 14-watt lamps, to which it is particularly adapted, is suitable for individual seat lighting. Since 20 lamps may be operated by one converter unit of this type, and there are 40 seats in the average coach, only two converter systems are required for seat lighting. Aisle lighting may be handled with 40 of these lamps arranged in a continuous strip.

The voltage doubler system also has wide application for diners and club cars. It makes possible the construction of small, compact power-conversion equipment and allows for the use of multiple power-conversion channels, so that in case of power failure of one unit, only a small percentage of the total lighting is lost. In a diner, for example, four voltage doublers, running the light load, would permit the use of eighty 14-watt lamps, which could be arranged artistically in three rows down the center and on either side of the car (20 over each row of seats and 40 down the aisle). This would mean an overall consumption of about 1,500 watts, allowing for all loss factors in the fluorescent system.

Since 14-watt white fluorescent lamps are currently rated at 485 initial lumens per lamp, the overall illumination provided would be 80 x 485, or 38,800 lumens.

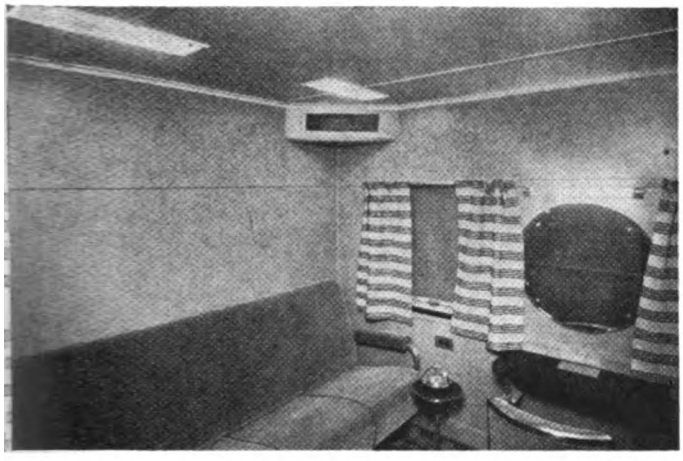


A type of lighting which may be accomplished with either long o short tubes

* President, Electronic Laboratories.

equal to 25.8 initial lumens per watt. This would produce an illumination of about 24-30 foot-candles without greatly increasing accepted incandescent lighting loads. Incandescent lamps offer far lower lighting levels, since they are based on lamps (25-watt, 60-volt) having an output of 285 initial lumens per lamp or only 11.4 per watt.

Another example of the use of fluorescent lighting, even where low lighting levels are desired, as in Pullman cars, is that of "black" (ultra-violet) light directed at carpeting, safety signs and upholstery and drapery. These are illuminated, for purposes of decoration, safety



An application of fluorescent lighting in a ladies' lounge

marking or identification, by dyeing or painting the objects with fluorescent material. Fluorescent materials have the advantages of giving off visible light when irradiated by ultra-violet light.

Black light may be furnished most efficiently by special fluorescent lamps covered by a glass filter to eliminate the visible spectrum and allow only the invisible ultra-violet to penetrate the tube. Such lamps are quite efficient with phosphorescent chemicals and in exciting fluorescent dies and paints. An example of effective black-light utilization is provided by the Santa Fe's El Capitan where carpets were dyed with special fluorescent dies to provide illumination at floor levels.

In planning illumination for compartment-type cars, it should be noted that since these are closed off from the aisle, a high-level continuous strip light arranged in the ceiling above the aisle can be used, and will produce a very practical and decorative effect. Slim-line lamps may readily be adapted for this purpose.

It might be pointed out, at this juncture, that there is a definite need for a low-wattage, smaller-size fluorescent visible light operating on 64 volts which could be used for individual berth illumination in Pullman cars. Six to ten-watt fluorescent lamps operated by a voltage doubler would be most suitable for this application. The development of such lamps would open the Pullman field to individual fluorescent lighting.

The vibrator-type voltage doubler consists of a vibrator and a group of condensers, the latter being charged in parallel and discharged in series by means of the vibrator. The efficiency of this system under full load is about 95 to 98 per cent, which is higher than any other conversion means known at this time. A typical unit weighs only about 12 lb. and has a capacity of about 300 watts. Most significant of all, it requires less battery current for a given light output, and the vibrators last 2,500 hours, or as long as the lamps. Parts are relatively inexpensive to replace. Wiring is simplified, since the car body may be used for the ground return.

System No. 2, designed to operate the new 93-in. cold-cathode instantaneous-starting tube can be used on railroads having voltages ranging from 32 to 600. About 800 volts are needed to operate two of these lamps in series and 1,600 are needed for operating four lamps in series. About 1,500 volts are needed during the two-lamp starting cycle. The high voltage needed for these lamps is obtained through the use of a step-up transformer and vibrator in combination. Advantages of the long, cold-cathode lamp include the elimination of many fixtures and considerable wiring, more even distribution of light, and the absence of annoying flicker when starting. This is especially important in 600-volt electrified railways which cross other tracks and switching points, causing frequent interruptions in circuit. Wiring is simplified, also, because no starting switches or other auxiliaries are necessary. The output is 22 lumens per watt, or twice that of an incandescent lamp in the same circuit.

System No. 3 is particularly well suited to railway lighting since it provides the highest lumen output through the use of 42-in. slimline lamps. Forty lumens per input watt are obtained, or over three times that from standard incandescent bulbs used for the same purpose.

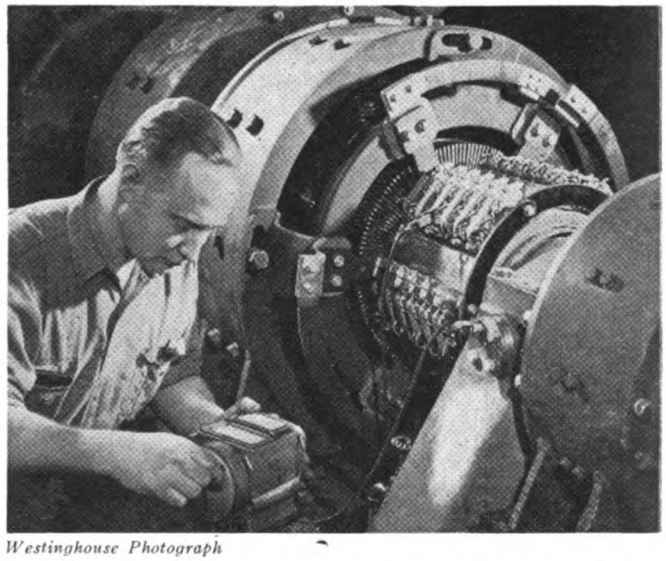
Automatic voltage regulation is provided over an input range of 28 to 40 volts, insuring constant light output. Other similar conversion equipment is available for 64- and 110-volt cars.

Ten to 14 lamps (42-in. slimlines) may be operated per power unit, three to four power converters being required per car. Individual reactors and starting switches are entirely eliminated.

System No. 4, which operates sixteen 30-watt lamps in parallel, allows individual control of lamps, and offers 27 lumens per watt, but, because of the added wiring needed and the individual reactors required for each lamp, is a more costly system.

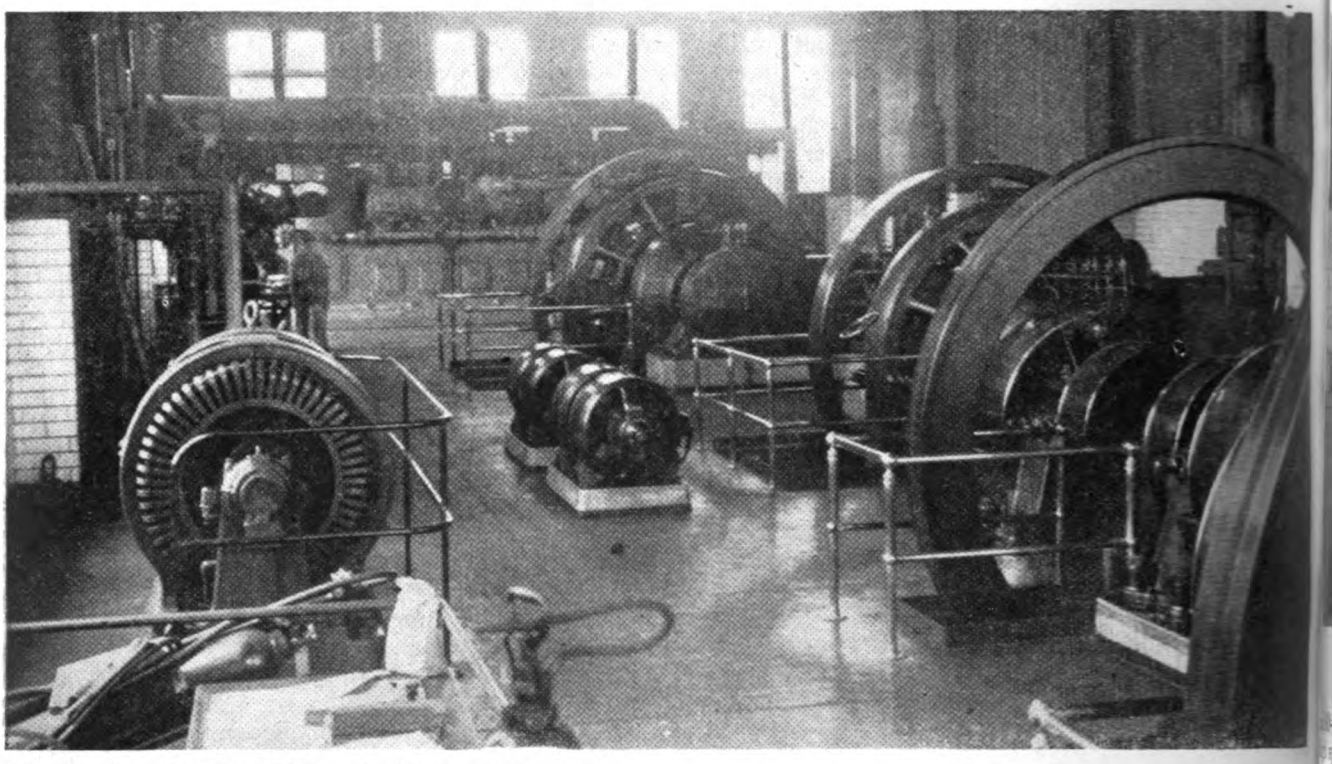
Because good lighting is so important in transportation, the use of fluorescence is certain to increase in the future. Installations such as those illustrated herewith demonstrate the high levels of illumination obtainable through its use, not to mention the greater eye-appeal and the artistic interior design possibilities offered by straightline and circular lamp construction.

* * *



Westinghouse Photograph

Measuring insulation resistance, an important part of a preventive maintenance program—Since electrical insulating materials are non-conductors only when dry and clean it is important to keep all equipment dry and clean as accumulations of dust and dirt not only contribute to insulation breakdown but they operate to increase the motor temperature through restrictions of ventilation

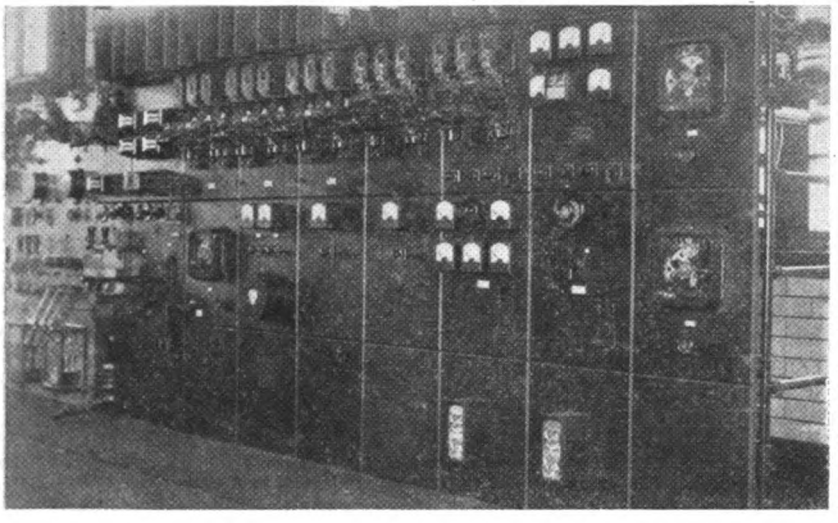


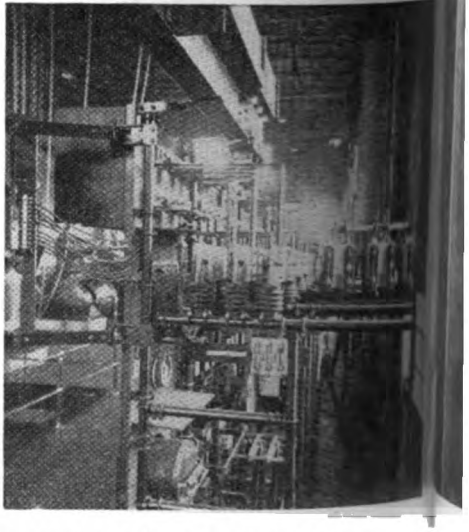
The power plant, showing the Diesel engine in the background

Stationary Diesel Power Plant

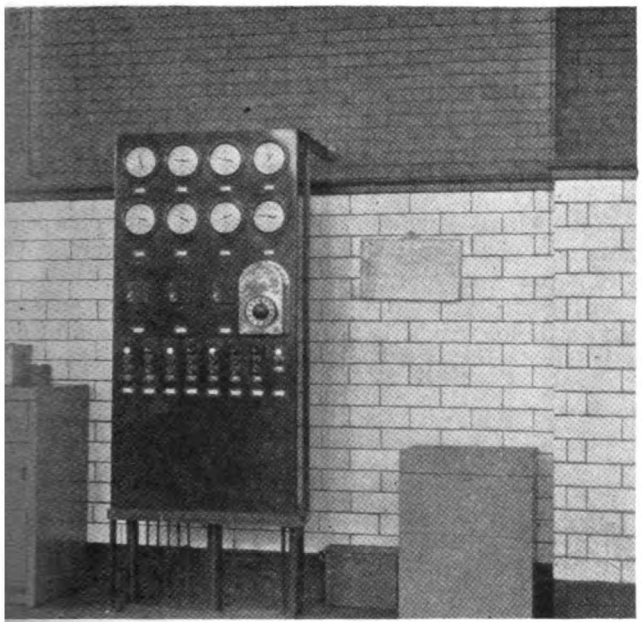
Rock Island makes estimated saving of $24,000 a year by replacing steam with Diesel unit

MOST of the electrical power for the Chicago, Rock Island & Pacific shops in Silvis, Ill., is now derived from a 1,125-kw. Diesel-driven generator which is replacing a 360-kw. Corliss engine-driven generator with rope drive. No power is purchased and the complete equipment includes in addition to the Diesel unit, a Curtis steam-turbine driving a 480-volt, 600-kw. 8-power factor generator,





Left: The main switchboard—Right: Back of the switchboard showing the connection with the overhead bus bars



Engine gauge panel

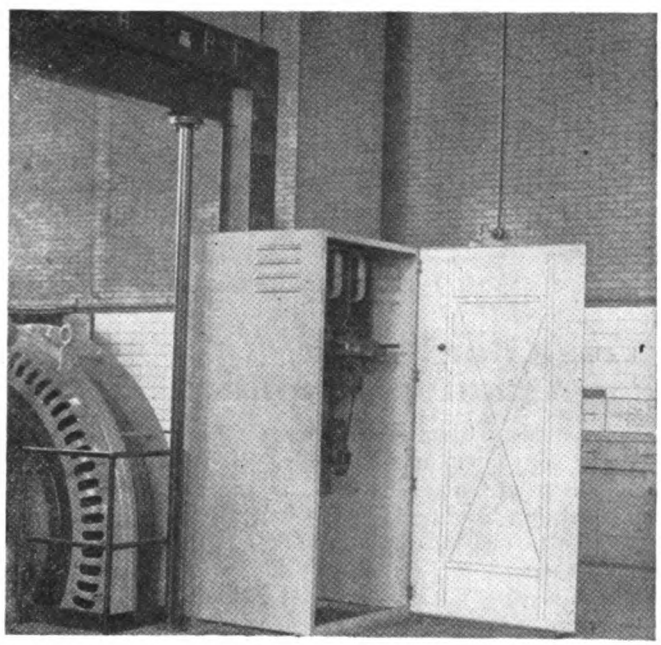
a 500-kw., 230-volt d.c. generator driven by a Buck-eye high speed piston valve engine, a similar 250-kw. d.c. generator with similar engine drive, and a 300-kw. reversible motor generator set.

The Diesel unit was installed because more power was needed and because the old engine was obsolete. The turbine and motor generator set are normally used at night when the load is light. The Diesel and one of the d.c. generators are used in the day time. The estimated reduction of cost of operation affected by the change is $24,000 per year. This is made up largely of fuel cost.

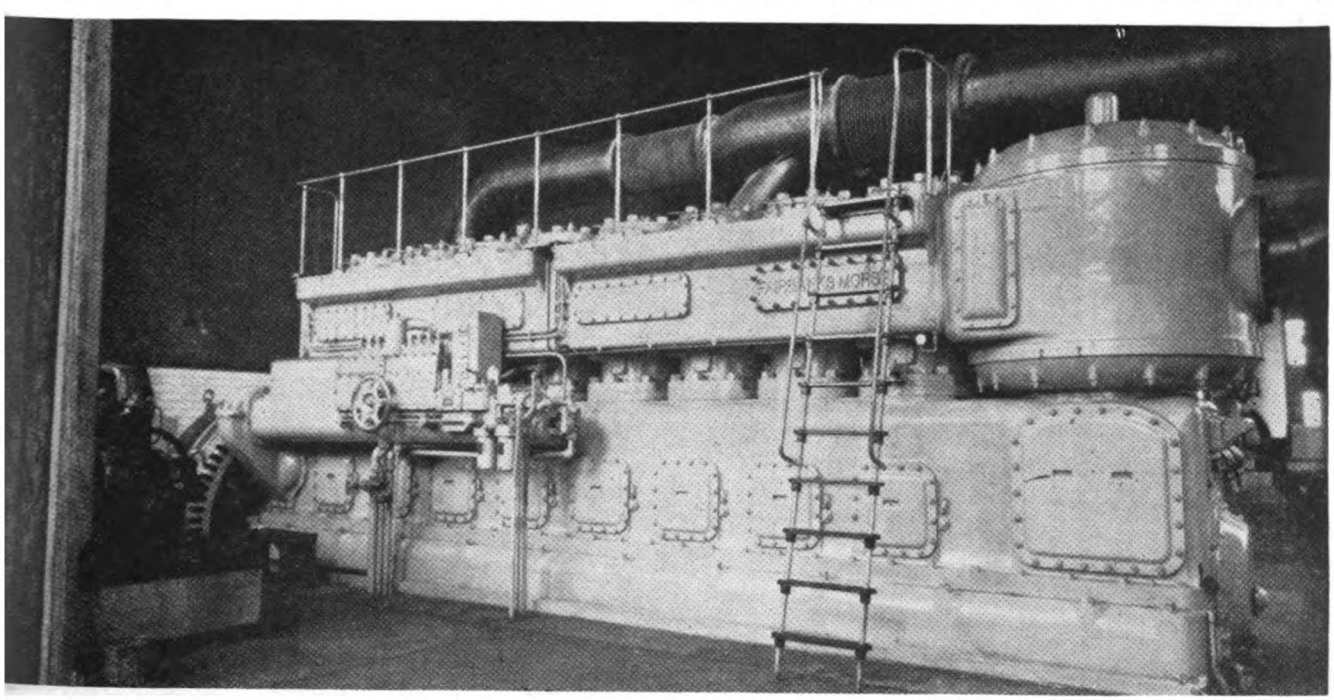
The new engine is an eight-cylinder model 33-E 16 by 20 Fairbanks-Morse Diesel engine. It is rated 1,600 hp., runs at 300 r.p.m. and is directly connected to a three-phase 60-cycle 480-volt a.c. generator rated 1,125 kw. at 0.8 power factor. A direct connected exciter unit is used for field excitation.

Current from the generator is carried to a floor-mounted cubical enclosed circuit-breaker and because the currents are large they are transmitted from the circuit-breaker to the switchboard by means of overhead bus bars. These bus bars are enclosed in a perforated metal casing and are run overhead as shown in one of the illustrations since the basement below the engine room is somewhat crowded with existing piping and did not provide much headroom. For the same reason, the exhaust pipe and air intake pipe are shown above the floor and high enough to permit easy passage way.

Accessory to the Diesel engine are heat exchangers for jacket water and lubricating oil. A 5-in. pump driven by a 10-hp. motor circulates the jacket water through the engine and through the heat exchanger. A 5-in. pump with a 20-hp. motor is used to circulate the raw water



Circuit breaker cubicle with enclosed bus bars brought out at the top



The engine is rated at 1,600 hp. and is direct-connected to a 480-volt, three-phase, 1,125-kw. generator

which may be obtained from the existing spray pond or from an existing well, the latter being equipped with a deep-well turbine. A third 5-in. pump is used as a standby for either the raw water or the soft water, and the piping arrangement permits its being cut into either system. These three split-case pumps with the heat exchangers are located in the basement of the building adjacent to the foundation of the engine.

The pond which constitutes one of the two sources of raw water is a storage reservoir for the water supply system for the entire terminal and is used as a cooling pond for the condensers in the power plant and after treatment the water is used for feed water in steam boilers and for locomotive tender tanks. Its summer excess of heat is dissipated by spray nozzles on the return system. The well water offers a temperature advantage for use through the Diesel heat exchange but it must be wasted after use as it is too hard for re-delivery to the spray pond.

Another engine auxiliary is the gauge-panel which includes pyrometer equipment and starting stations for the various pumps that are used with the engine. The push-button stations are all of the indicating type which show the operator at all times which pumps are in use.

Two new panels were added to the power switchboard. These include a new voltage regulator for the Diesel engine and one for the steam turbine which is retained as a standby and for the night load.

Weigh Bar For Armature Banding

Tight bands for traction armatures are assured by a simple and convenient method developed in the Union Pacific's shops at Omaha, Neb. The armature to be banded is placed in a banding lathe, as shown in Fig. 1, in which it can be turned by the lathe motor. The banding wire is taken from a reel on a stand shown in the foreground through a pair of friction blocks on the top of the stand. to a clamp at the pinion end of the traction armature shaft as shown in Fig. 2. The armature is then turned and the banding wire is guided along the shaft to the guide plate shown close to the armature in Fig. 2. This plate is secured to an arm which in turn is mounted on the shaft.

As the first turn of banding wire is applied to the armature, the banding clips are applied. These are shown in Fig. 2. One loop of the banding wire is carried over the tension pulley. The space between the ends of the banding clips is filled with closely spaced turns of wire, and then the wire is wound in widely spaced loops to the commutator end where it is again clamped securely. The wire is then cut from the spool.

To assure even tension of the proper value on each turn, a 35-lb. weight is first hung at the left end of the weigh bar (Fig. 1). A chain hoist, shown above the man's head in Fig. 1, functions as a fulcrum and permits leveling of the bar during the tensioning operation. The distance from the chain block support to the weight is four times the distance from the chain block support to the tension pulley support at the right end of the weigh bar. The rope block at the extreme left end of the bar

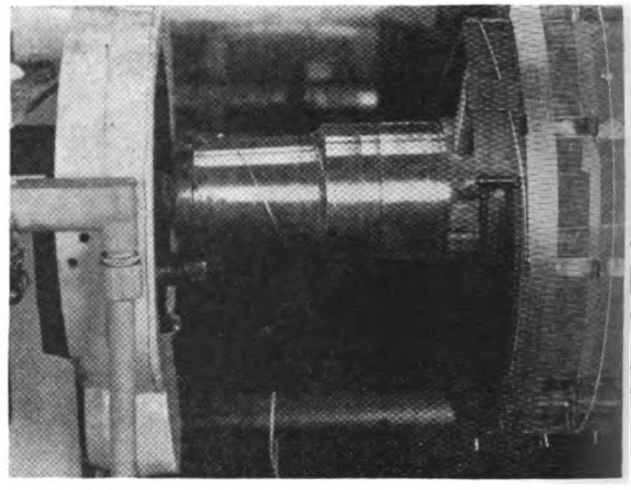


Fig. 2—A close-up of one end of the traction motor in the banding lathe showing how the banding wire is applied

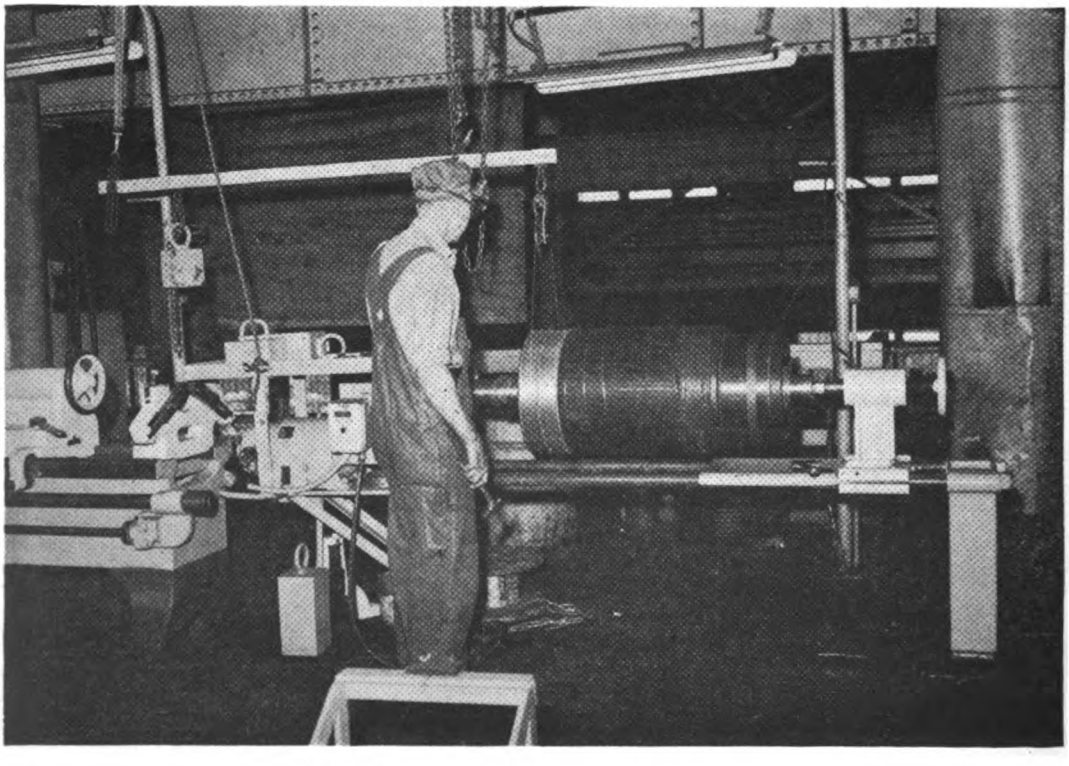


Fig. 1—The weigh-bar at the upper left applies tension to the pulley in the center over which is run one loop of the banding wire

keeps the weight from falling in case the banding wire should break.

The armature is then rotated in both directions to make two passes of the tensioning loop across the bands. The 35-lb. weight is then replaced with a heavier one, a 120-lb. weight being used for the lower band and a 100-lb. weight for the top band of a Type D-7 motor. The bands on the commutator end are similarly applied.

Although band wire breakage is infrequent, it is imperative that the operators wear goggles during the banding operations. All armatures are rebanded at 250,000 mile intervals.

CONSULTING DEPARTMENT

Selection of Transformer Locations

Why are apparently similar sets of transformers sometimes installed in vaults and sometimes on poles or pole platforms? What factors govern the choice of installation?

Can you answer the following question? Answers should be addressed: Electrical Editor, *Railway Mechanical Engineer*, 30 Church Street, New York 7.

We are experiencing much trouble with dirty cooling coils and evaporators on our air-conditioning equipment. Some of this trouble comes from neglect and a great deal from dirt or bad order filters. Would it not be possible to improve this condition by using centrifugal type filters or dust collectors such as are used on locomotive air pumps?

Non-Flammable Cooling Liquid May Offer Added Advantage

The most important factors affecting the choice of the location and method of mounting of a set of power transformers are the desirable proximity to load centers, the special circumstances of the area to be served, the voltage, the rating, method of cooling, type and quantity of the cooling liquid, proximity of combustible materials, the availability of fire-proof or fire-resistive enclosures, and the standards of the local electrical inspection department.

In spite of all electrical protective devices, transformers are a potential source of fire hazard and their live wires a constant menace to the life of careless workers and unqualified persons. No protective measure, therefore, is too elaborate to provide for the protection of life and property in operating transformers. Transformers operating at higher than 600 volts are subject to more rigid restrictions than those operating at 600 volts or less.

Insulation breakdown causes intense heat to be developed, evolving dense smoke, especially in oil-filled transformers whose oil may become ignited and boil over. Mistaking the smoke of coil insulation for fire and pouring of streams of water usually aggravates conditions and causes heavier losses. In view of the foregoing, it is advisable to isolate transformers by installing them in fire-proof vaults or outdoor substations where the existence of such stations is consistent with safety in thickly populated regions and their location will not interfere with firemen. Evidently, in an economical design, the point of power transformation and load center are placed as close together as local circumstances will permit. When not isolated by elevation, transformers and their lines should be kept beyond the reach of unauthorized persons by an enclosure bearing a warning sign indicating the highest voltage within the enclosure.

Transformers filled with a "liquid that will not burn" such as inerteen or pyronol, present several advantages over transformers filled with a "liquid that will burn" such as oil. They do not require costly vaults but should be installed away from wall openings and combustible building parts. A wire grill enclosure covers the requirements in most cases. They are desirable where installation space is at a premium. The possibility of locating this type of transformers comparatively closer to load centers results in better voltage regulation and considerable saving on the length of feeders of large size. Direct mounting on walls without an intervening space is avoided to prevent damage by electrolysis or charring caused by leakage currents. Wooden or preferably angle iron separating brackets are used as supports in mounting transformers on non-combustible walls. Oil-filled transformers of 25 kva. each or less than 75 kva., total rating may be installed indoors without a vault or fire-resistive enclosure if a concrete basin at least 6 in. deep is provided to hold the oil contents of the largest transformer and combustible materials and parts of the building are not within danger of igniting. The oil contents in gallons together with the kva. rating, voltage of each winding, and supply frequency should be stamped on the nameplate of each transformer. When not installed near combustible material, a transformer of 10 kva. or less may be installed in a building without a vault or fire-resistive enclosure. When local conditions necessitate the use of oil-filled transformers on the roof of a building or under a sidewalk adjacent to a building, they must be enclosed in a fire-proof vault.

For practical reasons of safety, continuity of service, and economy, transformers of over 600 volts and their high tension wires should be kept outside the building, even in central station practice wherever practicable. Where installed indoors by special considerations or permission, the location of the vault should be as close as possible to the point at which high tension wires enter the building. Provision should be made for the adequate ventilation, damming up or drainage of oil and water, ample space within the enclosure for easy access to parts, and secure locking to keep out unauthorized persons. When the total capacity of transformers in a vault does not exceed 100 kva., a door sill high enough to dam up all the oil in the vault may replace the drainage system. Transformers rated at more than 25 kva. and using a "liquid that will not burn," must be provided with a metal pan or basin large enough to hold the cooling liquid of the largest transformer. The foregoing may be eliminated if provision can be made to absorb the gases produced by arcing or discharging such gases into a chimney or flue through a pressure relief vent. All live parts must be enclosed or isolated where they may present a potential source of hazard.

In outdoor installations, the distance between the building and transformers is largely determined by the amount of oil contained in the largest transformer which may be involved in a fire. The high tension wires are so distanced from buildings as not to be a fire hazard or, in case of a fire, become a source of hazard to firemen fighting the fire with hose streams.

R. G. CAZANJIAN

NEW DEVICES

Car Wheel Grinder Has Increased Capacity

In 1939 the American Car and Foundry Company, New York, made available a car-wheel grinder for the tread grinding of mounted wheel pairs on centers, the original design of which has been installed in a number of railroad shops since that time. Changed conditions with respect to the sizes of wheels to be handled have dictated several design changes in this machine which are now offered in the machine being delivered on current orders.

The original machine was described in the *Railway Mechanical Engineer* for August, 1939, page 326. The present model embodies the basic principles of design of the original machine in which the motor-driven grinding heads are mounted adjustably on bracket extensions of the bedplate and grinding-wheel spindles mounted parallel to the treads of the wheels. The entire abrasive wheel and motor assemblies are retractable from the working position to effect a clear path through the machine for wheel pairs. This feature of design makes it possible to locate the machine in any desirable position in the shop layout.

The tailstocks of the present machine are heavier in construction and retain the same principle of bed plate mounting as well as the eccentric mounting of the tailstock spindles. The throw of the spindles, however, has been increased to accommodate a greater range of machine capacity for where the original machine accommodated car wheels of from 28 in. to 37 in. diameter the improved machine can handle all sizes of wheels from 24 in. to 45 in. This feature is of special interest to roads with Diesel motive power.

The motor equipment of the present machine consists of two 25-hp. 1,800-r.p.m. alternating-current motors for driving the alternating-current motor for the feeder motor for rotating the work. All motors operate on 220-440 volts.

The machine is supplied with two 30-in. by 2¼-in. grinding wheels of the purchaser's specifications for either chilled or rolled-steel wheels.

The wheel-tread grinder occupies a floor space approximately 11 ft. by 25 ft. and weighs 28,000 lb. in working order.

Silicone Insulating Varnish

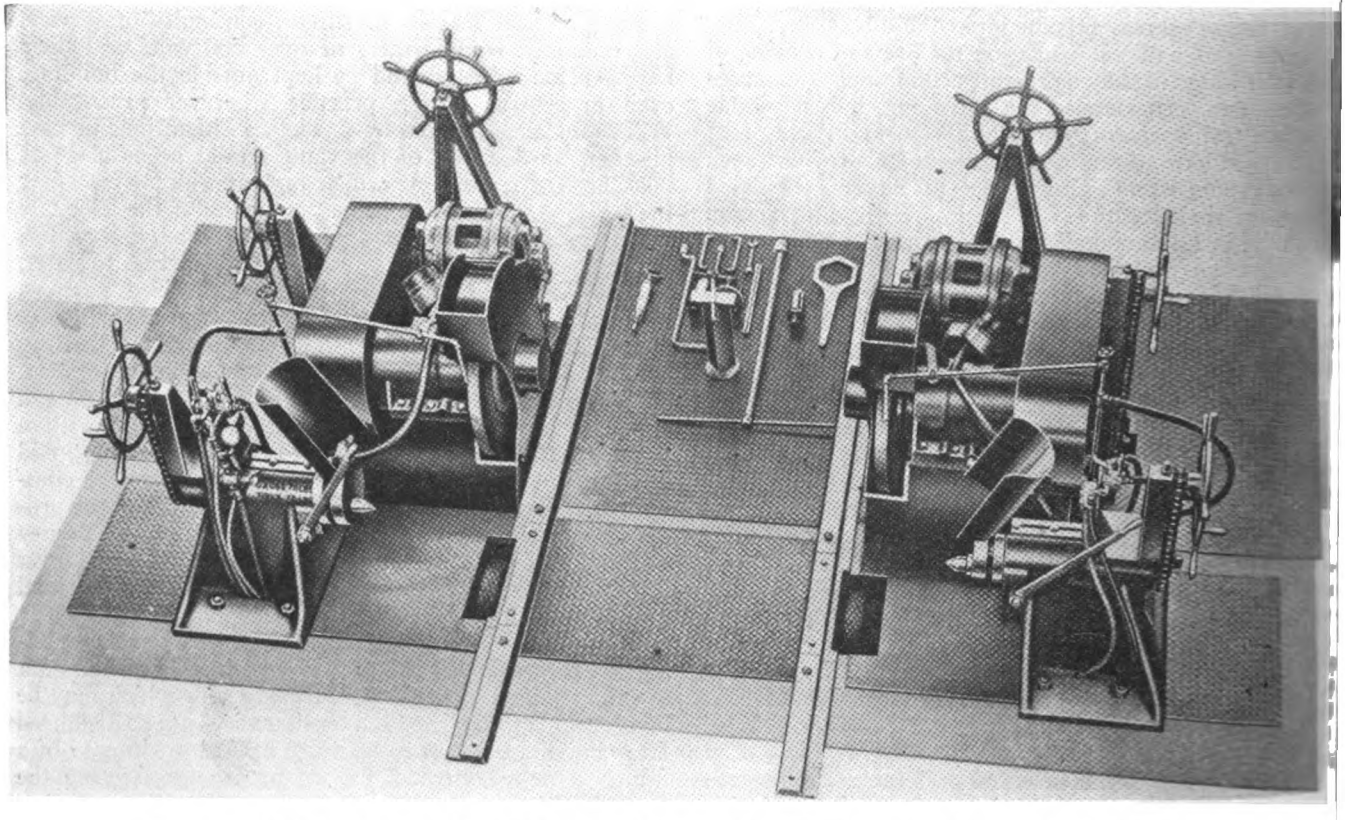
A heat-stable, waterproof varnish for impregnating electrical equipment, which cures at 300 deg. F., is now being produced by Dow Corning Corporation, Midland, Mich. It is known as DC-996.

Electrical equipment wound with silicone insulating materials and sealed by impregnating with DC-996 will have the high order of thermal stability and the retention of the waterproof characteristics of silicone insulation. Silicone insulating materials impregnated and bonded with DC-993 are available through leading distributors of electrical insulations. DC-996 can be cured at temperatures obtainable in ovens now used for curing organic varnishes.

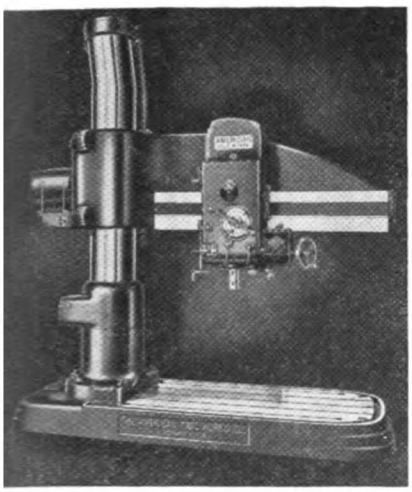
Another advantage of the new silicone varnish is that electrical equipment can be baked fully assembled without damaging the commutators or the slip rings. The temperature required to cure DC-996 does not affect shellac-bonded mica or core plating.

American Radial Drill

The design of a new model radial drill made by the American Tool Works Company, Cincinnati 2, Ohio, introduces a patented spindle drive that is said to have added so materially to the efficiency of radial-drill functioning that the production possibilities with this type of machine have been increased. The head is mounted on rollers for easy movement along the arm and all manual controls are centralized and concentrated so that complete operation may be effected from the most natural operating position. Safety features for protecting both the operator and machine have



The American Car and Foundry Company's wheel grinder now handles wheels from 24 in. to 45 in. diameter

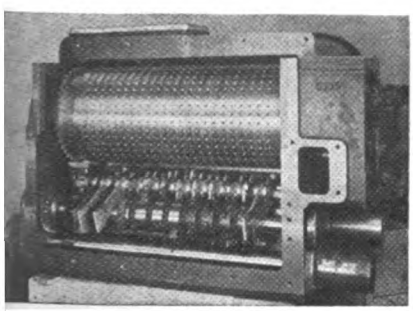


ladial drill with Double Lo-Hung spindle drive

een included as well as provisions for implifying functional controls to guard he operator against mistakes in manipulaion and from undue fatigue from his fforts.

Automatic Control for Vertical Turret Lathes

The Bullard Company, Bridgeport, Conn., as recently announced the availability of he Bullard Man-Au-Trol in combination vith the 30- and 36-in. vertical turret lathes f the Cut Master design and, when conlitions permit, the application will be exended to the 42, 54-, 64- and 74-in. sizes.



his drum, through dogs and contact levers, is ie determining factor in the selection of maine functions—The levers actuate hydraulic alves when the drum is indexed 1/40 revolution for each phase of the automatic cycle

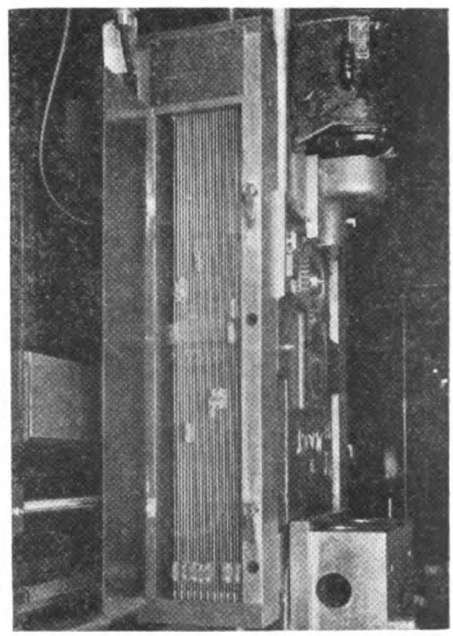
he Man-Au-Trol is an electro-hydraulic ontrol system which can be pre-set to perrm any number of separate functions up a maximum of 39 for each of the two eads of the machine. The machine is pret by machining a piece, by manual conol, and as each function of each head is mpleted the automatic control is locked. pon completion of the machining operions for this piece of work the machine ay be changed over to automatic operion and successive pieces duplicated with-t any manual control on the operator's rt.

When operating as an automatically conolled machine the automatic control may thrown out, at any point in the cycle, and the machine used in the conventional manner by manual control. It may then be returned to automatic control without having disturbed the tooling sequence.

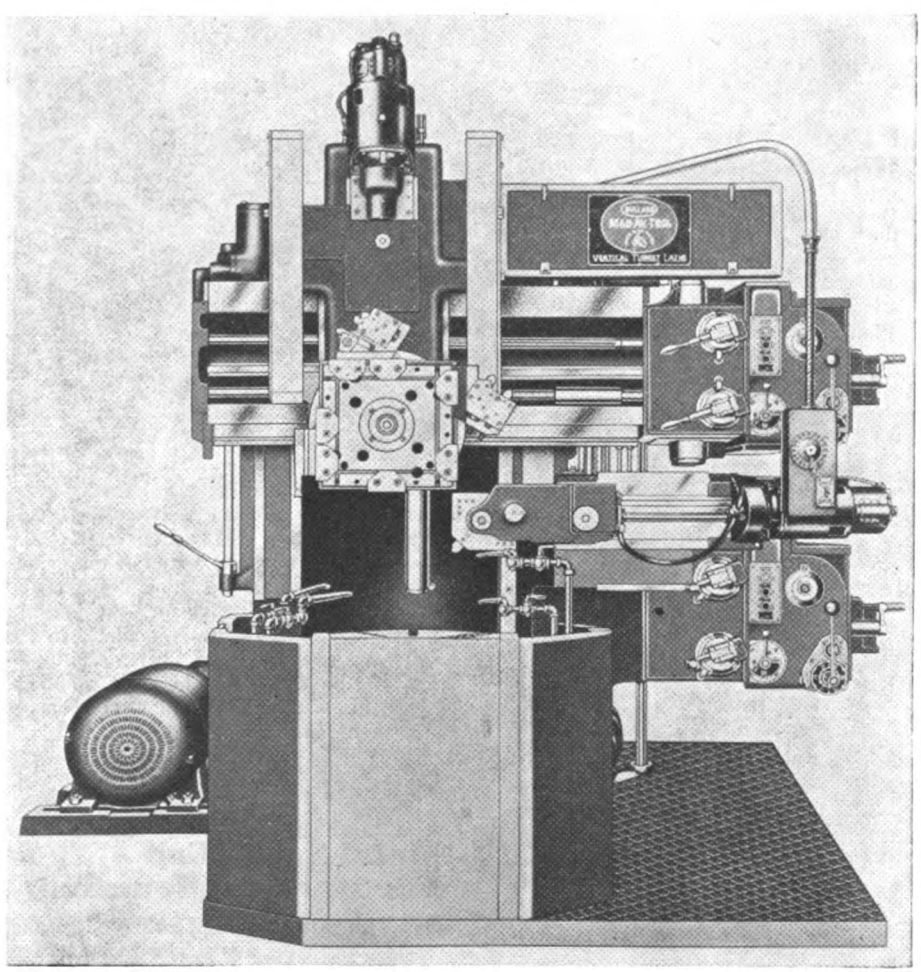
The Man-Au-Trol consists of two basic control elements, one, functioning electrically, has control over the beginning and end of each phase of the automatic cycle; the other, operating hydraulically, acts to select the operations which make up each phase of the automatic cycle.

The electrical element is made up of a frame carrying 20 pairs of parallel wires, on each pair of which is a sliding contact that is clamped to one of the wires and free to slide on the other. The wire to which the contact is clamped is equipped with a micrometer adjustment by means of which the position of the sliding contact is established. Since the feeding of tools into the work is one of the functions controlled by this electrical element and tolerances of ten-thousandths are required the necessity of means of accurate positioning of the sliding contacts is obvious.

The heart of the hydraulic selector system is a drum having 40 rows of holes extending the length of the drum. Dogs are set in these holes which, as the drum rotates, actuate levers controlling solenoid-operated hydraulic valves. These valves start and stop the various machine functions. At the end of the drum are 40 electrical connections leading to the electrical control element. As each of the 40, or less, dogs in the drum contacts a control lever a pair of wires in the electrical element are energized. Behind the banks of wires in the case of the vertical head, or below the bank in the case of the horizontal head,



Electrical controls determine the beginning and ending of each phase of the automatic cycle—A bank of switches behind the wires make contact with sliders as the head moves



36-in. Bullard Man-Au-Trol vertical turret lathe

there is a support with a row of 20 switches, one for each of the 20 sliding contacts. The hydraulic element selects, starts and stops the operation function through the control drum. The movement of the head, upon which is mounted this 20-switch bank, causes contact to be made with the slider on the energized circuit. When this takes place the drum makes another 1/40 revolution and a new set of hydraulic control valves operate to end or begin certain machine functions.

Each of the heads of the machine can be set to perform a maximum of 39 functions and settings can be made so that both heads may be in operation at the same time with provision made for prevention of interference. Tool wear is compensated for by the ability to make micrometer adjustments of the electric stops.

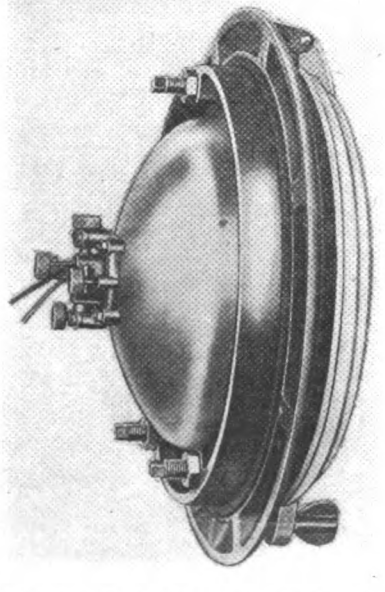
The vertical turret-lathe drive consists of main driving motors with auxiliary motors for the main and side heads. Two types of tables are available, either with three-jaw combination or four-jaw independent chucks. The three-jaw chucks are either manually or hydraulically operated, as desired.

Two general types of drive are available —the sliding gear and the change gear— and, depending upon the drive type and the motor speed, the spindle speed ranges are from a minimum of 3.3 r. p. m. to a maximum of 321.3 r. p. m. There are 16 feeds, in geometrical progression, varying from .0007 in. to .125 in. for each spindle revolution. Each head has independent feed works and the feeds are the same for both heads.

Flush Type Headlights

A headlight designated as Type NH for flush installation in a vertical surface such as required for streamline locomotives or cars has been made available by the Electric Service Manufacturing Company, Philadelphia, Pa. Because of the permanent installation of the body, provision is made for independent training of the beam and for that purpose the reflector shield, together with the reflector and socket, may be adjusted by three threaded brass studs.

The unit is mounted in a cast-iron ring having a steel back. The cast-aluminum front door is fitted with a moulded glass lens. The glass mirror reflectors are mounted on pads with backs protected by steel shields. Gold or crystal reflectors are optional. Sockets are designed for 100- to 250-watt, 32-volt lamps and are furnished either with a focusing device or pre-focused lamps.

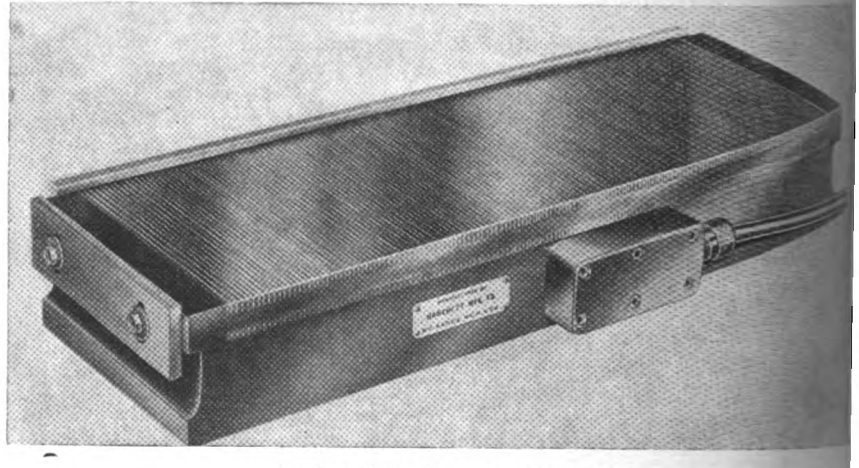


Side view of the flush type NH headlight

Magnetic Chuck With Laminated Top Plate

A laminated top plate of all-steel construction has been added to its line of electromagnetic chucks by the Hanchett Manufacturing Company, Big Rapids, Mich. Pole sections traverse the entire width of the chuck top. Laminations are composed of magnetic steel ⅛ in. thick and non-magnetic steel 1/32 in. thick. By utilizing all-steel top-plate construction, the entire top plate can be hardened. Because of the fine spacing of the poles, the smallest parts can be held without difficulty and a 22 per cent greater magnetic surface is available.

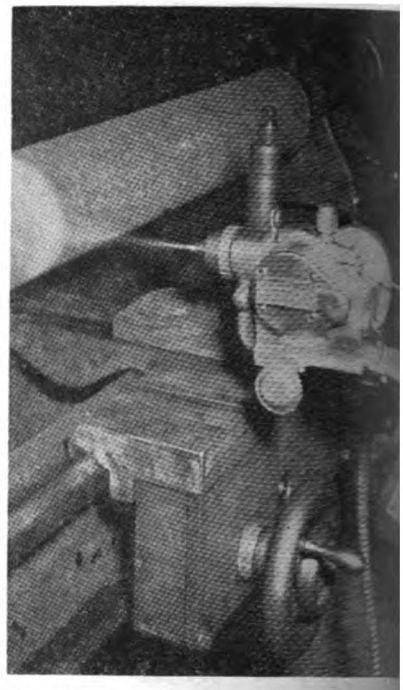
The coils are protected carefully from moisture. In addition, the installation of these coils in the chuck is arranged so that the magnetic flux will be transverse to the length or opposing the action of the grinding wheel or cutting tool thus reducing the possibility of work slippage. At present, this laminated top plate is available in the following sizes: 6 in. by 18 in., 6 in. by 24 in., 8 in. by 25 in., 8 in. by 36 in. and 8 in. by 48 in. Other sizes will soon be made available.



Laminated top plate magnetic chuck

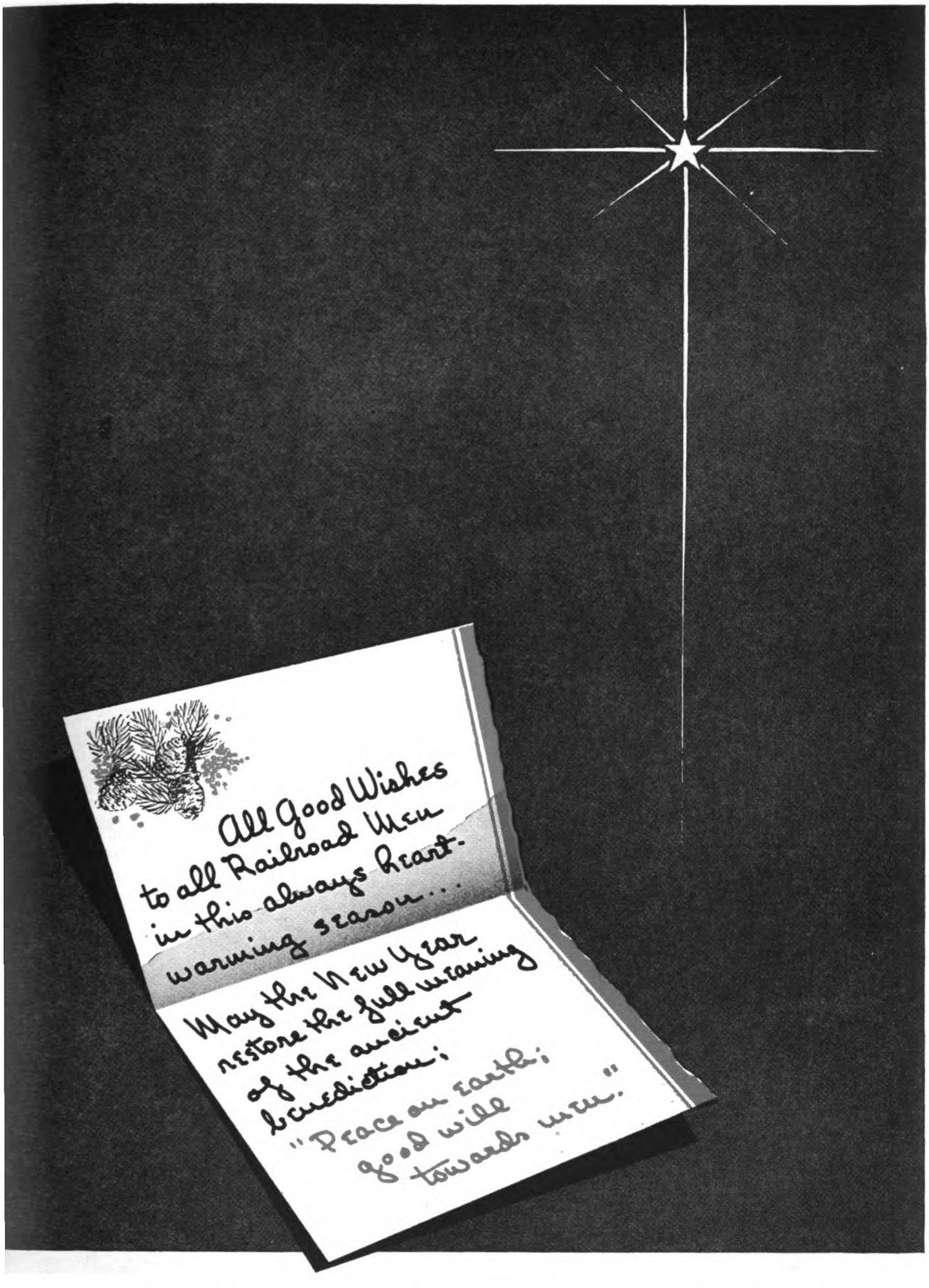
Metal Spray Gun For Machine Mounting

The Metallizing Engineering Company, 38-14 30th Street, Long Island City 1, New York, is manufacturing a metallizing gun designed for heavy-duty, continuous operation. This unit, known as the Metco Type Y metallizing gun, meets the demand for a metal-spraying gun that can be used for production and other heavy-duty metallizing jobs instead of just for intermittent operation. Its general construction, performance and other features are geared for mounted mechanical operation, rather than for hand use. Its features include the use of ⅛-in. wire which, when combined with an acetylene pressure of only 15 lb. per sq. in. more than doubles any previous spraying speeds.



Metallizing gun built for heavy duty continuous operation

Because it is designed without regard to the weight and size limitations necessary in the hand gun, the new gun is much heavier and more rugged in construction. Gears, worms and bearings are several times larger than any used previously. The gun has flush lubrication and a built-in force-feed pump which has no parts to wear assures an adequate supply of lubricant to all bearings regardless of operating position. The gun is non-sensitive to gas- and oxygen-pressure variations of as much as 10 lb. either while lighting or while spraying.



ASSOCIATION OF MANUFACTURERS OF CHILLED CAR WHEELS

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NEWS

A. A. R. Mechanical Division Letter Ballot Results

As AUTHORIZED by the General Committee of the A. A. R., Mechanical Division, the recommendations of various committees for changes in the standard and recommended practice of the division were submitted to letter ballot in the form of 25 separate propositions, in Circular D. V.-1090, dated August 24, 1945.

On the basis of letter ballot returns, it has been announced that Propositions 1, 3 and 4 are being held in abeyance pending further consideration by the General Committee, because of the substantial negative vote and the reasons advanced therefor. Propositions 2 and 5 to 25, inclusive, have been approved by the A. A. R. and are effective January 1, 1946.

Car Department Officers' Association—A Correction

F. E. CHESHIRE, president of the Car Department Officers' Association, whose picture in military dress appears on page 481 of the November *Railway Mechanical Engineer,* had attained the rank of Colonel some time before his return to civilian status as noted on page 479. G. R. Andersen, vice-president of the association, became superintendent car department of the Chicago & North Western a few months ago. His title was incorrectly given on page 481 as assistant superintendent car department.

Some P.R.R. Shopmen Choose C. I. O. Union

THE United Railroad Workers of America, Congress of Industrial Organizations, has supplanted the Brotherhood of Railroad Shop Crafts of America, Pennsylvania System, as the Railway Labor Act Representative of P. R. R. boilermakers, molders, power house employees and railway shop laborers, according to results of a recent election which has been certified by the National Mediation Board. P. R. R. machinists, blacksmiths, sheet metal workers

Orders and Inquiries for New Equipment Placed Since the Closing of the November Issue

LOCOMOTIVE ORDERS

Road	No. of locos.	Type of loco.	Builder
Alton	10[1]	1,000-hp. Diesel-elec.	American Loco. Co.
Central of New Jersey	5[2]	4,500-hp. Diesel-elec. frt.	Baldwin Loco. Works
Pennsylvania	10[3]	6,000-hp. Diesel-elec. pass.	Electro-Motive
Virginian	4[4]	500-ton electric	General Electric Co.

FREIGHT-CAR ORDERS

Road	No. of cars	Type of car	Builder
Southern Pacific	50[5]	Caboose	American Car & Fdry.

FREIGHT-CAR INQUIRIES

Southern	1,000[6]	Automobile	

PASSENGER-CAR ORDERS

Road	No. of cars	Type of car	Builder
Baltimore & Ohio	8[7]	Sleeping	Pullman-Standard
Boston & Maine—Maine Central	16[8]	Coaches	Pullman-Standard
	4[8]	Restaurant-lounge	Pullman-Standard
	4[8]	Coach-smoking-lounge	Pullman-Standard

PASSENGER-CAR INQUIRIES

New York Central	214[9]		

[1] Purchase authorized by Federal Judge Philip L. Sullivan. The order will consist of eight locomotives for $87,138 each, and two train-heater, boiler-type locomotives at $93,262 each.

[2] Purchase price, subject to tests, approximately $1,877,500.

[3] Each locomotive will consist of four 1,500-hp. units coupled together with control cabs at both ends.

[4] Motor-generator type, for delivery in 1946. The locomotives will have a short time rating of 8,000 hp. and a continuous rating of 6,800 hp. The weight on drivers will be 500 tons and the starting tractive force 260,000 lb. based on 26 per cent adhesion. Continuous tractive force at 15.75 m.p.h. will be 162,000 lb. Two 4,000-hp. motor generator sets, mounted within the cab structure, will supply energy to d.c. traction motors geared to the 16 driving axles under the two-cab unit. The motor generator sets will work on the 11,000-volt, 25-cycle overhead contact system, with which the Virginian line is equipped. Power is supplied by coal-burning power plants. The locomotives will be used to haul 10,000-ton coal trains on heavy grades. They are geared for a maximum speed of 50 m.p.h.

[5] For delivery early in 1946. The cars will have bay windows and will cost approximately $317,000.

[6] Bids closed.

[7] Each car will have 16 roomettes equipped with single bed, lavatory and toilet facilities, and four double bedrooms, which will be convertible into suites. The cars are scheduled for delivery in the third quarter of 1946.

[8] To be of lightweight stainless steel and to cost approximately $2,000,000.

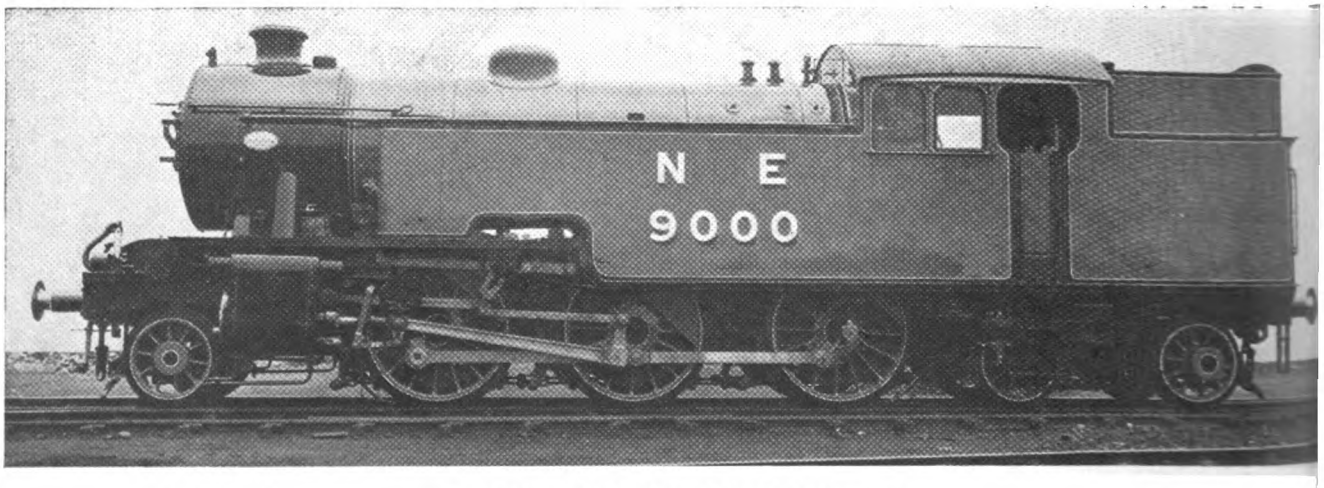
[9] For 14 trains. Bids closed.

Notes:

The *Chicago, Rock Island & Pacific* has received authorization to purchase 53 passenger cars and 25 automobile freight cars at cost in excess of $5,600,000. The passenger equipment includes 16 day-coach cars, 11 chair-night coaches, 2 parlor cars, 3 parlor-observation cars, 5 sleeper-room cars, 4 dining cars, 5 baggage cars, 3 room-lounge cars and 4 cars of a type not yet specified.

The *Gulf, Mobile & Ohio,* through its board of directors, has authorized the purchase of 24 Diesel-electric locomotives, 20 of which will be for freight service, two as road switch engines and two 2,000-hp. for streamline passenger-train service.

The *Missouri-Kansas-Texas* has completed plans for the purchase of six 1,000-hp. Diesel-electric switching engines at a cost of $475,500. These locomotives will be used to Dieselize switching operations in the Dallas, Tex., terminal completely.



A London & North Eastern Class L1 locomotive

The locomotive is the first of a new design to be built in Britain since VE Day; the first in the railroad's five-year plan for the construction of 200 new locomotives, and the first British tank locomotives to be fitted with electric head and tail lamps and electric lighting in the cab—It has outside cylinders 20 in. by 26 in., a boiler pressure of 225 lb., and a tractive force of 32,000 lb.

COAL FOR THE NEEDS OF PEACE

Virginian Railway 2-6-6-6 built by Lima

The Lima-built 2-6-6-6s The Virginian Railway placed in service to handle the war's tremendous coal traffic demands, are already speeding fuel to meet the needs of reconverting industries.

Capable of hauling the heaviest freights, over mountain grades, at sustained high speeds, these giant steam locomotives meet the highest standards of motive power efficiency.

IMA LOCOMOTIVE WORKS LIMA LOCOMOTIVE WORKS INCORPORATED INCORPORATED, LIMA, OHIO

electrical workers and carmen were also involved in the election, but these groups voted to retain the brotherhood as their representative.

Bangor & Aroostook electrical workers, carmen, power house employees and railway shop laborers, previously represented by a local committee, have chosen unions operating through the Railway Employees Department of the American Federation of Labor.

Capt. C. L. Combes Returns to R. M. E. Editorial Staff

CAPT. C. L. COMBES, until August 1, 1941, associate editor of the *Railway Mechanical Engineer*, when as a reserve field artil officer he was called for duty, was retur to inactive status on October 15, 1945, has again taken up his duties as assoc editor. Captain Combes' first mili assignment was with the 52nd Coast Ar lery (Railway) as a battery officer. He assigned to the Coast Artillery Schoo an instructor in November, 1941, hand railway artillery problems. Upon com tion of his duties at the Coast Artil School in August, 1943, he became exe tive officer for the northern half of harbor defenses of Los Angeles, Calif., u April, 1944. He was then transferred to Ordnance Department and became ch of the Editorial Branch, Research and D velopment Service, Ordnance Departm where he remained until his return to ci ian life.

Capt. C. L. Combes

Supply Trade Notes

SAFETY CAR HEATING & LIGHTING CO.—*E. K. Goldchmidt* has been released from active duty as a lieutenant commander in the Naval Reserve and has returned to the Safety Car Heating & Lighting Co. as representative in the Chicago office. Mr. Goldschmidt became associated with the Safety Company in 1933. In 1942 he enlisted and was assigned to duty with the industry cooperation division of the Navy in Washington, D. C., and Chicago.

R. L. Hillpot

R. L. Hillpot has been appointed manager of the Southwestern district of the Safety Car Heating & Lighting Co. with headquarters in Philadelphia, Pa. Mr. Hillpot has been associated with the company since 1915, excepting for a short period of service in the maintenance of way department of the Pennsylvania, and in the Navy during World War I. From 1939 until assuming his present duties, he served as representative in the southeastern district.

◆

WESTINGHOUSE AIR BRAKE COMPANY.—UNION SWITCH & SIGNAL COMPANY.—*Albert Nathaniel Williams*, of New York, president of the Western Union Telegraph Company, has been elected vice-chairman of the boards of directors of the Westinghouse Air Brake Company and the Union Switch & Signal Company. Mr. Williams, who has been a member of the boards of both companies since last February, will assume his new post as vice-chairman on January 1. *Herbert A. May*, assistant to the president of the Westinghouse Air Brake Company and vice-president of the Union Switch & Signal Company, has been elected a member of the board of directors of both companies.

◆

LINCOLN ELECTRIC COMPANY.—*H. F. Kneen* has been appointed vice-president in charge of manufacturing, and *G. G. Landis*, vice-president in charge of engineering for The Lincoln Electric Company, Cleveland, Ohio.

Mr. Landis is a veteran of over 20 years with Lincoln Electric. He received his electrical engineering education at Ohio State University, receiving a Bachelor of Science degree in 1922. After two years with several large electrical companies, he resigned to enter the laboratories of Lincoln Electric in 1924. He became chief engineer in 1930. Mr. Landis is a director of the company and has complete charge of the design and production engineering on welding equipment manufactured by the company. He is a member of the American Welding Society.

◆

KROPP FORGE COMPANY.—*James E. Sweeney*, works manager, has been appointed vice-president and general sales manager of the Kropp Company.

◆

ELWELL-PARKER ELECTRIC COMPANY.—*F. J. Avery*, general sales representative with headquarters in Chicago for the Elwell-Parker Electric Company, Cleveland, Ohio, has been appointed in charge of sales to railroad companies in the Chicago-midwest district. Mr. Avery has been associated with Elwell-Parker since 1936. Previously he was a consulting engineer.

REYNOLDS METALS COMPANY.—*Albert Charlton* has been appointed sales mana of the aluminum division of the Reyn Metals Company, with headquarters Louisville, Ky. Mr. Charlton had been ea ern sales manager for the aluminum di sion in New York.

◆

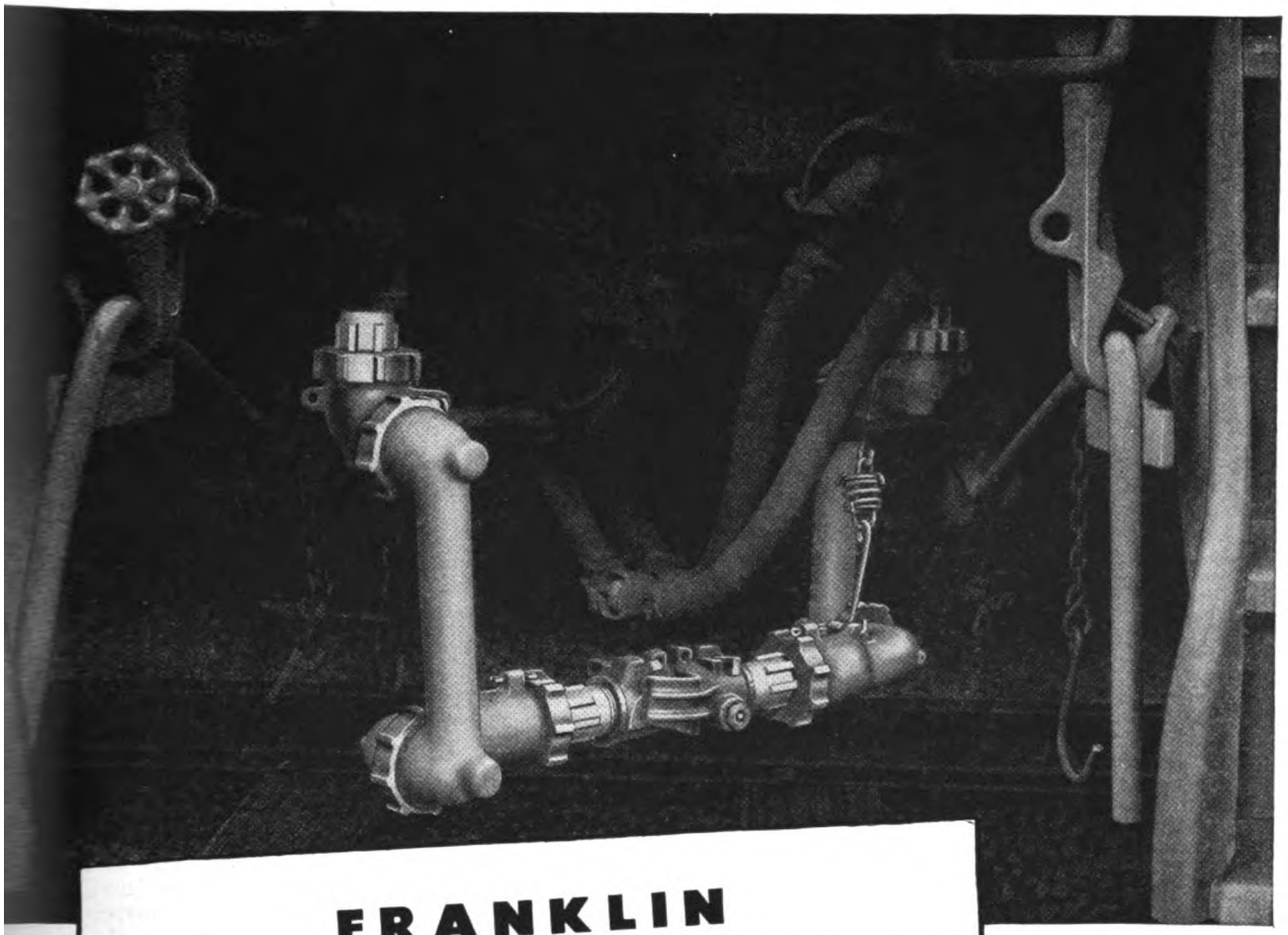
ALLIS-CHALMERS MANUFACTURING COMPANY.—*Dr. J. T. Rettaliata*, who recen was appointed director of the mechani engineering department at the Illinois Ins tute of Technology, will continue his as ciation with the Allis-Chalmers Manufa turing Company as consultant on gas tu bine development and similar problems.

◆

GRAYBAR ELECTRIC COMPANY.—*E. O'Donnell*, manager of the railroad depar ment, has been appointed manager of tran

E. J. O'Donnell

portation sales for the Graybar Elec Company. In his new assignment M O'Donnell will report directly to gene headquarters in New York although he be located in Chicago, where he has employed since joining the company 1910.



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CAR CONNECTIONS
have these *4 Vital Features*

1. Low Frictional Resistance to Joint Movements
2. Minimum Leakage
3. Low Maintenance Cost
4. Dependability of Performance

Franklin sleeve-type design provides ease of movement and tight connections, so that steam pressure drop is extremely low.

An additional valuable feature is the ease with which the low-cost gaskets can be replaced.

These factors result in a steam conduit which can be maintained at minimum expense.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK • CHICAGO

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ALLEGHENY LUDLUM STEEL CORPORATION. —The Allegheny Ludlum Steel Corporation has placed first on its peacetime expansion program the immediate erection of a $2,000,000 research laboratory and experimental center at its headquarters plant, Brackenridge, Pa. With the new facilities, an enlarged and intensified program of fundamental and applied research will be brought to bear on the highly specialized stainless, magnetic, valve, tool, and other complex steels produced by the company. In addition, new and improved fabricating techniques will be developed, to bring increased aid to the manufacturers of appliances and equipment used in American homes, businesses and industries.

◆

ELECTRONIC LABORATORIES, INC.—Electronic Laboratories, Inc., Indianapolis, Ind., has announced that the following new jobbers have taken on sales distribution for the company's auto radio vibrator replacement lines: Radio Wire Television, Inc., Boston, Mass.; Radio Products Sales, Denver, Colo.; Radio Electric Products, Buffalo, N. Y.; Radio Products Sales Los Angeles, Calif.; Scott Radio Supply, Long Beach, Calif.; Hatry and Young, Hartford, Conn.; the Roehr Distributing Company, St. Louis, Mo.; the R. and R. Part & Supply Co., Inc., Lubbock, Texas; and the Central Missouri Distributing Company, Jefferson City, Mo.

◆

AMERICAN LOCOMOTIVE COMPANY.—*Carl J. Dinic* has been appointed executive assistant to the president of the American

Carl J. Dinic

Locomotive Company. Mr. Dinic became associated with the company in July, 1943, as assistant to the president. Prior to that he was with the United States Steel Corporation, Pittsburgh, Pa., and with Eastern Gas & Fuel Associates, Boston, Mass.

◆

GENERAL STEEL CASTINGS CORPORATION. —*Comm. B. W. Taylor* has been appointed assistant chief mechanical engineer of the General Steel Castings Corporation. Commander Taylor recently was released from active duty by the Navy Department. He is a graduate of Pennsylvania University with a degree in mechanical engineering (1917). He served in the United States Army and in the Navy in the first world war. He was instructor in mechanical engineering at Pennsylvania University from 1920 to 1923. In the latter year he joined the SKF Industries, Inc. From 1933 to

Comm. B. W. Taylor

1943 he was railway engineer of that company, in charge of engineering and service in all matters pertaining to railway applications. He returned to naval service in August, 1943, and served for approximately two years with the bureau of aeronautics.

◆

CUTLER-HAMMER, INC.—*F. A. Wright* has been appointed assistant general sales manager of Cutler-Hammer, Inc., Milwaukee, Wis. Mr. Wright has been associated with Cutler-Hammer since 1927.

◆

DEARBORN CHEMICAL COMPANY.—*F. B. Horstmann,* technical director of the railroad department of the Dearborn Chemical Company, has retired after 40 years of service. Mr. Horstmann entered service with the company in 1905 as a chemist, and in 1917 he was appointed chief chemist. In March, 1922, he was assigned to the industrial department, and in June, 1926, became chemical engineer of the railroad department. In 1941 he was appointed technical director.

◆

CUMMINS ENGINE COMPANY. — The Cummins Engine Company has reorganized its sales department, creating two new sales divisions. Under the new plan, sales activities will be divided into two major fields —direct sales through dealers, and sales to manufacturers who power their equipment with Cummins Diesels. *Paris E. Letsinger* is the company's vice-president in charge of distribution. *Norman E. Palmer,* for the past three years Washington, D. C., representative for Cummins, has been appointed general sales manager to work directly with Mr. Letsinger. *J. D. Allen,* assistant sales manager, has been appointed sales manager of dealer organizations, and *Fred W. Sparks,* manager of the Cleveland, Ohio, regional office, has been appointed sales manager of manufacturing accounts.

◆

CINCINNATI LATHE & TOOL CO.—Incorporation papers have been filed for a new concern, the Cincinnati Lathe & Tool Co., which has acquired the land, buildings, machinery, designs, inventory, unfilled orders, and trade name of the Cincinnati Lathe & Tool Company, Oakley, Ohio. The new company is a subsidiary of the Cincinnati Milling Machine Company, but will be entirely independent in operation. The Cincinnati Lathe & Tool Company has discontinued manufacturing operations because of the retirement of its president, *W. C. Heindel.* The new officers are *Millard Romaine,* president, and *E. W. Mueller,* secretary-treasurer.

◆

ELECTRONIC LABORATORIES, INC.—*B. G. Twyman & Associates* have been appointed distributors for the Electronic Laboratories, Inc., of Indianapolis, Ind., in Illinois and eastern Missouri, outside of the metropolitan districts of Chicago and St. Louis, Mo. The territory of *A. E. Rodman,* west coast representative, has been increased to include Nevada and Oregon.

◆

BALDWIN LOCOMOTIVE WORKS. — The Southwark division of the Baldwin Locomotive Works has placed field sales engineers in five of the company's branch offices in order to give better service to users of the SR-4 strain gage. The men and their offices are *Richard Hannon,* Boston, Mass.; *Joseph Farley,* Chicago; *Robert Cleeton,* New York; *Glenn Rowell,* Philadelphia, Pa.; and *Stanley Zansitis,* Detroit, Mich.

Robert G. Allen has been appointed general sales manager of the Baldwin Locomotive Works. Mr. Allen was educated at Harvard University. He joined the Walworth Company in 1925 and was division sales manager from 1929 until 1936. He then served two terms (1936-1940) as representative of Pennsylvania in the United States Congress. He was elected president of the Duff-Norton Manufacturing Company in 1940. In July, 1942, he was granted a leave of absence to accept a commission as a major in the Army.

Robert G. Allen

served as chief of the tank branch and later as executive officer of the Philadelphia, Pa., ordnance district. He was promoted to the rank of lieutenant colonel in February 1943, and a few months later transferred to field service and overseas where he served as a battalion commander and a group commander. He was returned to the United States in November, 1944, and placed on the inactive list January, 1945. He joined the Baldwin organization as general manager of the Baldwin Southwark division in March 1945.

IT'S A GREAT NEW DAY FOR RAILROADING

Someday the dramatic role that General Motors Diesel locomotives played during the war may be told. The speed with which vital war material and supplies were spirited across the land to Pacific coast ports will be one for the book.

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ADD SECURITY TO VICTORY • BUY MORE VICTORY BONDS

ELECTRO-MOTIVE DIVISION

GENERAL MOTORS CORPORATION • LA GRANGE, ILL.

FAIRBANKS, MORSE & CO.—*Charles H. Morse, III,* president of the Inland Utilities Company (a subsidiary of Fairbanks, Morse & Co.), has been elected vice-president of Fairbanks, Morse. Mr. Morse will continue as president of the subsidiary. In his new position he will be in charge of research, patents, and the western pump division on the parent company.

Frank E. Ross, Jr., heretofore in charge of the Diesel locomotive section of the U. S. Railroad Mission in Mexico, has been appointed assistant to *John W. Barriger, III,* manager of the Diesel locomotive department of Fairbanks, Morse & Co., with

Frank E. Ross, Jr.

office at 600 S. Michigan Avenue, Chicago. Mr. Ross was born at St. Louis, Mo., on July 25, 1916, and was educated in the public schools of St. Louis and in night extension courses at Washington University in that city. He entered the service of the Terminal Railroad Association of St. Louis as an electrician apprentice in 1936 and advanced through the maintenance of equipment and transportation departments to foreman of the company's Diesel locomotive repair shop. He left the T. R. R. A. in August, 1944, to go to Mexico with the railway mission, which was the connection he relinquished to join Fairbanks, Morse.

◆

IRON & STEEL PRODUCTS, INC.—*James C. Magee* has been appointed manager of the machinery department of Iron & Steel Products, Inc., with headquarters at Chicago. *Charles A. Marshall,* manufacturers' representative in the southern West Virginia territory, has been appointed sales engineer, with headquarters also at Chicago.

◆

GENERAL MOTORS CORPORATION.—*Louis F. Stuebe* has rejoined the Chicago sales enginering staff of the Hyatt Bearings division of the General Motors Corporation. Mr. Stuebe, who will specialize in Hyatt railroad applications, has been associated with Hyatt as a sales engineer since June, 1925. He was recently released as a Colonel from the Army.

◆

PULLMAN-STANDARD CAR MANUFACTURING COMPANY.—*James B. Rosser,* administrative assistant to the president of the Pullman-Standard Car Manufacturing Company, at Chicago, has been elected a vice-president in charge of sales of railroad equipment, with headquarters at New York. *Fred W. Alger* and *John C. Bell,* sales agents at Chicago, have been appointed assistant vice-presidents with headquarters at Chicago.

◆

GENERAL ELECTRIC COMPANY.—*L. D. T. Berg,* for the past five years a sales engineer in General Electric Company's electric welding division, Schenectady, N. Y., has been appointed welding specialist, Atlantic district, with headquarters in Philadelphia, Pa.

◆

ELWELL-PARKER ELECTRIC COMPANY.—*J. P. Lyons* has retired as Ohio district sales representative for the *Elwell-Parker Electric Company,* Cleveland, Ohio

◆

COPPERWELD STEEL COMPANY.—*Harry C. Dever* has returned to the Glassport, Pa., division of the Copperweld Steel Company and has been placed in charge of the Atlanta, Ga., office to cover the states of Georgia, Florida, South Carolina and North Carolina. Mr. Dever had been on a three years' leave of absence with the armed forces. Prior to the war, he covered the southeastern part of the United States for Copperweld.

◆

AIREON MANUFACTURING CORPORATION.—*Kenneth D. Halleck,* Washington sales representative for the past two years for the Aireon Manufacturing Corporation and before that, representative for the company on its army contracts with the Signal Corps procurement district in Philadelphia, Pa., and Dayton, Ohio, has been elected a director of the company. Mr. Halleck will transfer to the company's headquarters in Kansas City, Mo., as administrative assistant to the executive vice-president.

◆

EVANS PRODUCTS COMPANY.—*Edward S. Evans, Jr.,* chief executive of the Evans Products Company, Detroit, Mich., has been elected president of that firm, succeeding his father, E. S. Evans, whose death on September 6 was reported in the October issue. *Prewitt Semmes,* secretary and general

Edward S. Evans, Jr.

counsel, has been elected a member of the board of directors. Mr. Evans was born at Richmond, Va., and is a graduate of the University of Michigan and the University of Lausanne, Switzerland. He went to Detroit with his father in 1915 and during the ensuing years he became familiar with every phase of the business. After holding various positions with the company he was elected vice-president and also became a member of the board of directors. In 1935 he was elected to the position of chief executive.

◆

AMERICAN SMELTING & REFINING COMPANY.—*Aubrey M. Callis* has been appointed sales manager of the Whiting, Ind., and Detroit, Mich., plants of the Federated Metals division of the American Smelting & Refining Co. Mr. Callis, formerly assistant general manager of the Pacific Coast department with headquarters at Los Angeles, Calif., has been associated with Federated since 1928 in sales and plant executive capacities.

◆

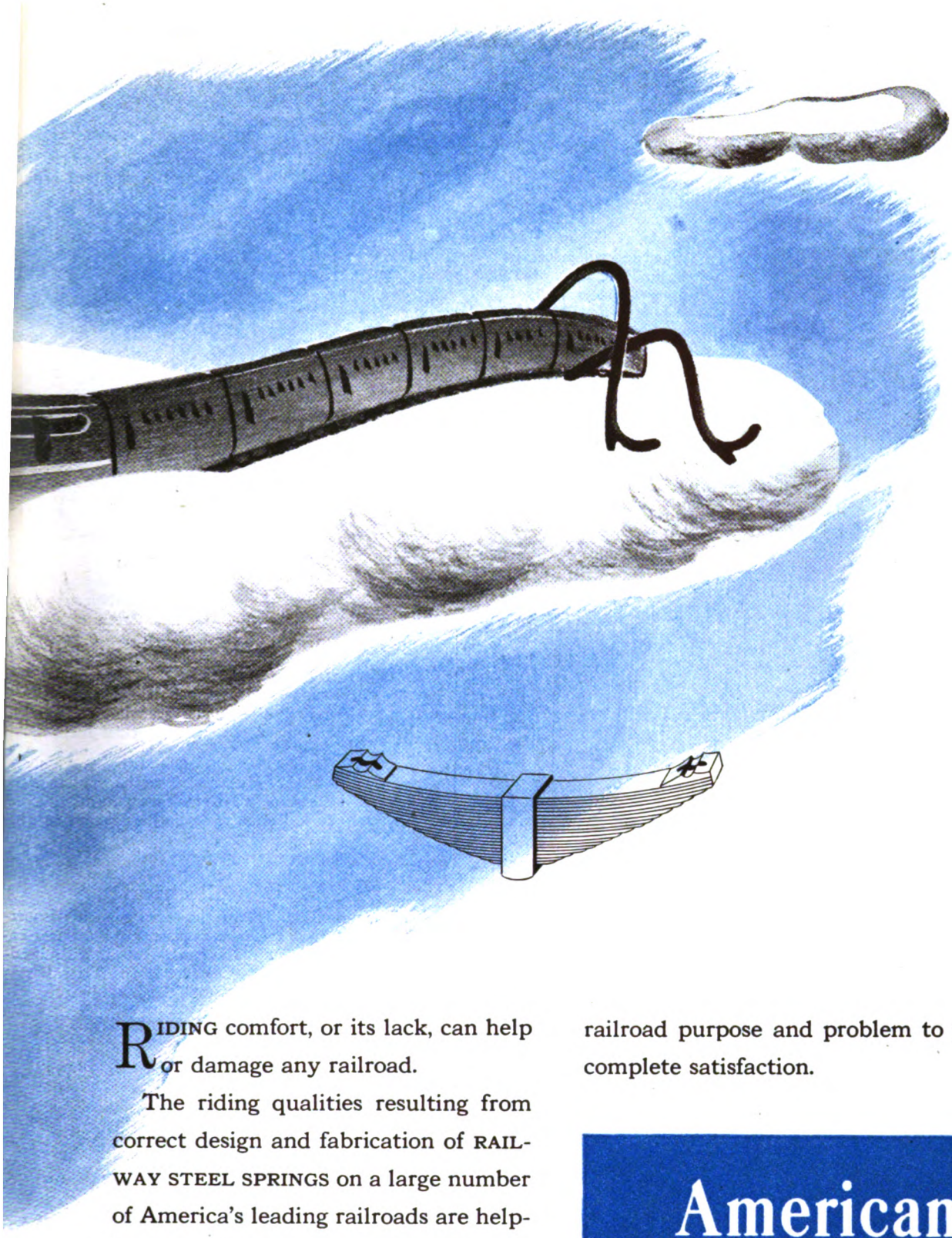
UNION SWITCH & SIGNAL CO.—*Charles M. Wheeler,* assistant district manager, has been appointed district manager of the Union Switch & Signal Co. with headquarters in New York. Mr. Wheeler is a graduate of the Pennsylvania State College with a bachelor of science degree (1911) and an electrical engineering degree (1913). He began his career as a

C. M. Wheeler

signal apprentice on the Pennsylvania in July, 1911, and was advanced through different positions until his appointment as assistant supervisor of signals in March, 1916. From March, 1918 to March, 1921 he held the positions of assistant division operator and division operator at Pittsburgh, Pa., after which he served on the E. & A., eastern and Pittsburgh divisions, as supervisor telegraph and signals. He left the Pennsylvania in September, 1927, to become sales engineer for the Union Switch & Signal Co., and in October, 1940, was transferred to New York as assistant district manager.

Obituary

MORTIMER R. KEMPTON, engineer of freight cars of the Pullman-Standard Car Manufacturing Company, died on November 8 while on a vacation at Martinsville, Ind. Mr. Kempton was born in 1887. In 1910 he went with the car-building firm of Haskell & Barker, Michigan City, Ind., and in 1922, when that company was merged with Pullman-Standard, he joined the latter organization.



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Personal Mention

General

FRANK E. RUSSELL, whose retirement as chief mechanical engineer of the Southern Pacific was reported in the November issue of the *Railway Mechanical Engineer,* was born at Davis, Calif., on September 25, 1875. He became a laborer in the employ

F. E. Russell

of the Southern Pacific at Sacramento, Calif., in September, 1899. He served for a short time in the office of the stores department and in 1900 was assigned to the office of the mechanical engineer, with headquarters at Sacramento. In 1903 Mr. Russell was promoted to the position of lead draftsman and three years later became chief locomotive draftsman, also at Sacramento. In 1917 he was appointed assistant mechanical engineer, with headquarters at San Francisco, Calif.; in 1924 mechanical engineer, and on January 1, 1944, chief mechanical engineer.

JOHN MCMULLEN has retired as consulting engineer of the Erie at Cleveland, Ohio. Mr. McMullen was born in Balley Keel, County Down, Ireland, on December 20, 1871, and came to the United States in 1886. He entered railway service in 1888

John McMullen

as an apprentice in the Buffalo car shop of the Erie. He became a carpenter and cabinetmaker there in 1892 and a gang foreman in 1896. From 1904 to 1906 Mr. McMullen served as passenger-car foreman, then as shop superintendent in North Paterson, N. J. He served as general piecework inspector at Meadville, Pa., until his appointment as shop superintendent at Kent, Ohio, in 1907. He transferred to Buffalo, N. Y., in 1912, where he was appointed superintendent, car department, system, in 1913. Mr. McMullen became consulting engineer in 1941.

J. H. WHIPPLE, JR., who has been appointed superintendent of Diesel equipment of the Denver & Rio Grande Western as announced in the October issue, was born on November 3, 1912, at Topeka, Kan. He is a graduate of Topeka High School (1930) and of the General Motors Institute of Technology, Flint, Mich. (1934) Mr.

J. H. Whipple, Jr.

Whipple began his career with the D. & R. G. W. as system shop engineer in March, 1942. In July, 1942, Mr. Whipple became assistant Diesel supervisor; on August 1, 1943, Diesel supervisor, and on August 1, 1945, superintendent Diesel equipment, with headquarters at Denver, Colo.

THOMAS H. EVANS, whose appointment as chief mechanical officer of the Missouri-Kansas-Texas with headquarters at Parsons, Kan., was reported in the November issue, was born at Whitewright, Tex., on October 15, 1899. He entered the employ of the M-K-T on March 15, 1916, as a machinist apprentice at Denison, Tex., completing his apprenticeship on April 5, 1920. After a brief period of service as a machinist with the St. Louis-San Francisco at Oklahoma City, Okla., he returned to the M-K-T as a machinist at Denison. In April, 1921, he became a machinist in the

Thomas H. Evans

employ of the Louisiana & Northwestern at Homer, La. He again returned to the M-K-T as a machinist at Waco, Tex., on August 25, 1923, and subsequently served as gang foreman and general foreman. Mr. Evans became shop superintendent on February 1, 1940, and served in that position until his appointment as chief mechanical officer.

M. W. MCMAHON, special appliance inspector of the New York Central at New York, has been appointed assistant to general superintendent motive power, with headquarters at New York.

In Military Service

BRONZE STAR MEDAL

Maj. Albert D. Hartzler, of Cincinnati, Ohio, formerly mechanical supervisor of the Cincinnati Union Terminal, recently was awarded the Bronze Star Medal at Marseilles, France, "for outstanding service as mechanical engineer and, as head of Requirements Section, Headquarters, Second Military Railway Service, from May 1, 1944, to March 20, 1945."

Electrical

J. M. TRISSAL has been appointed superintendent communication and electrical engineer of the Illinois Central, with headquarters at Chicago. Mr. Trissal was born on December 30, 1903, in Chicago. He

J. M. Trissal

attended high school in Chicago, and is a graduate of the University of Illinois with a degree of Bachelor of Science (1925). He received the degree of Elec-

trical Engineer in 1940. He entered railroad service as a draftsman in the signal department of the Illinois Central during the summer of 1924. In June, 1925, he returned to the Illinois Central signal repartment, and in 1926 was transferred to the electrical department of the Chicago Terminal Improvement and appointed junior engineer, later serving as assistant engineer. Following the completion of the electrification program in June, 1930, Mr. Trissal was appointed assistant electrical engineer fixed property, reporting to W. M. Vandersluis, general superintendent of telegraph and signals. In November, 1931, Mr. Trissal became electrical engineer; fixed property.

A. D. MACPHERSON, electrical engineer, department of research and development, of the Canadian National at Montreal, Que., has been appointed controller of test materials and research there.

Master Mechanics and Road Foremen

ROBERT GUY FIELD, who has been appointed master mechanic of the Cincinnati, New Orleans & Texas Pacific at Ludlow, Ky., as announced in the October issue, was born on August 4, 1897, at Macon, Ga. He attended high school and during 1914-15, through correspondence, took the Central of Georgia Railway Educational Bureau Engineering Course. On February 10, 1911, he became a toolroom boy in the employ of the Georgia Southern & Florida at Macon, Ga., and from February 11, 1913, until December 10, 1917, he was a machinist apprentice. He then entered the service of the Southern as a machinist at Birmingham, Ala. On April 16, 1923, he became enginehouse foreman at Greensboro, N. C. He returned to Birmingham on February 21, 1925, as assistant enginehouse foreman. From February 2, 1926, until April 2, of the same year he served as a machinist and from the latter date until July 17, 1926, was a machinist supervisor. He became night enginehouse foreman on July 17,

R. G. Field

1926; assistant foreman enginehouse on January 26, 1927; and day enginehouse foreman on May 2, 1932. On June 1, 1934, Mr. Field was transferred to the Somerset, Ky., shops of the Cincinnati, New Orleans & Texas Pacific as day enginehouse foreman. He returned to the Southern on February 20, 1937, as enginehouse foreman at Princeton, Ind.; on December 13, 1939, became enginehouse foreman of the Cincinnati, New Orleans & Texas Pacific at Somerset, and on May 16, 1941, general enginehouse foreman of the Southern at Birmingham. On March 16, 1942, he was transferred to the New Orleans & North Eastern as general foreman at Meridian, Miss., and on January 1, 1945, was appointed assistant master mechanic. He became master mechanic of the C. N. O. & T. P. at Ludlow on September 1, 1945.

ROBERT J. DUNN, district foreman of the Union Pacific at North Platte, Neb., has been appointed master mechanic, with headquarters at Denver, Colo.

JAMES E. GOGERTY, master mechanic of the Union Pacific at North Platte, Neb., has been transferred to the position of master mechanic at Cheyenne, Wyo.

Car Department

ROBERT SCHEY has been appointed superintendent of the car department of the New York, Chicago & St. Louis, with headquarters at Cleveland, Ohio. The position of general superintendent car department has been abolished.

Shop and Enginehouse

BERNARD COOK, who has been appointed superintendent of shops of the Norfolk & Western at Roanoke, Va., as noted in the October issue, was born on October 20,

Bernard Cook

1886, in Roanoke. He is a graduate in civil engineering of the Virginia Polytechnic Institute (1928). On November 1, 1909, he entered the service of the Norfolk & Western as assistant engineer tests. On August 1, 1925, he was appointed mechanical inspector; on May 16, 1927, general foreman locomotive department, and on September 1, 1945, superintendent of shops at Roanoke.

Obituary

E. A. PARK, superintendent of motive power and equipment of the Peoria & Pekin Union at Peoria, Ill., who had been on leave of absence since October 20, died recently in that city.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers, preferably on company letterhead, giving title. State the name and number of the bulletin or catalog desired, when it is mentioned.

POWER HAMMERS. — McKiernan-Terry Corporation, Park Row Building, New York 7. Bulletin 56, "The Mechanical Blacksmith's Helper," describes in detail the design and construction of the McKiernan-Terry Blacker power hammer, with specifications and sectional drawings.

◆

SILICONES.—Dow Corning Corporation, P. O. Box 592, Midland, Mich. 12-page illustrated pamphlet, "Dow Corning Silicones, New Engineering Materials," descriptive of Dow-Corning silicones—compounds and greases, fluids, varnishes and resins, and Silastic, a silicone rubber.

◆

TRAIN COMMUNICATION EQUIPMENT.—Aireon Manufacturing Corp., Kansas City 15, Kan., "The Time Has Come," a 26-page illustrated booklet in stiff covers, describes the application of inductive and space radio communications systems to railroad service. In a pocket of the back cover is a separate bulletin on the company's inductive type of equipment and a photograph of its railroad radio laboratory which is used in a baggage car.

◆

"GLOSSARY OF MACHINE SHOP TERMS."—Kropp Forge Company, 5301 West Roosevelt Road, Chicago 50. 32-page booklet. Words and terms are defined as used in heavy machine shop practice, with recognition of the fact that other definitions are sometimes employed in various industries for describing identical process or operations.

◆

"FRICTION SAWING." — DoALL Company, Machine Tool Division, 1301 Washington avenue South, Minneapolis 4, Minn. 24-page booklet explains why friction sawing is possible; its advantages, and its limitations. Contains Job Selector chart for use in selecting proper sawing factors in cutting SAE steel, stainless steel, cast steel, and cast iron.

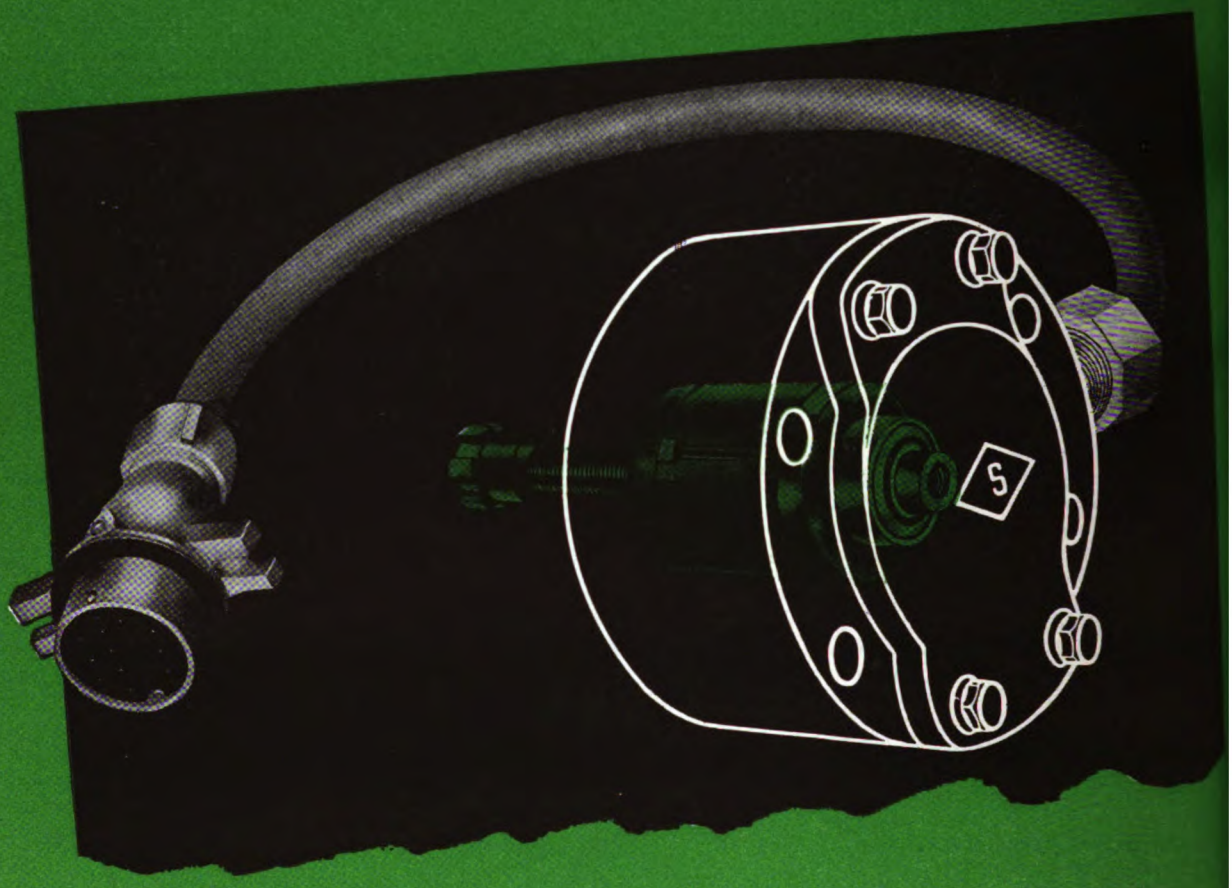
◆

CELLULAR RUBBER.—Sponge Rubber Products Company, Derby Place, Shelton, Conn. Four-page pamphlet, 845-21, describes various forms in which sponge rubber, bonded fibre and other sub-density materials are manufactured. Illustrates molded, die-cut and fabricated shapes of flexible, elastic compressible productions for cushioning, shock absorption, vibration dampening, etc.

◆

ELECTRICAL REPAIR EQUIPMENT.—Ideal Commutator Dresser Company, Sycamore, Ill. "Modern Motor-Generator Maintenance and Repair Equipment for Re-conditioning War Weary Machinery," a 36-page catalog which illustrates and describes a great variety of equipment used in electrical maintenance.

the American Brake Shoe



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• The simplicity of the American Brake Shoe Controller, is shown by the above drawing. There is but one moving part — a rugged rotor.

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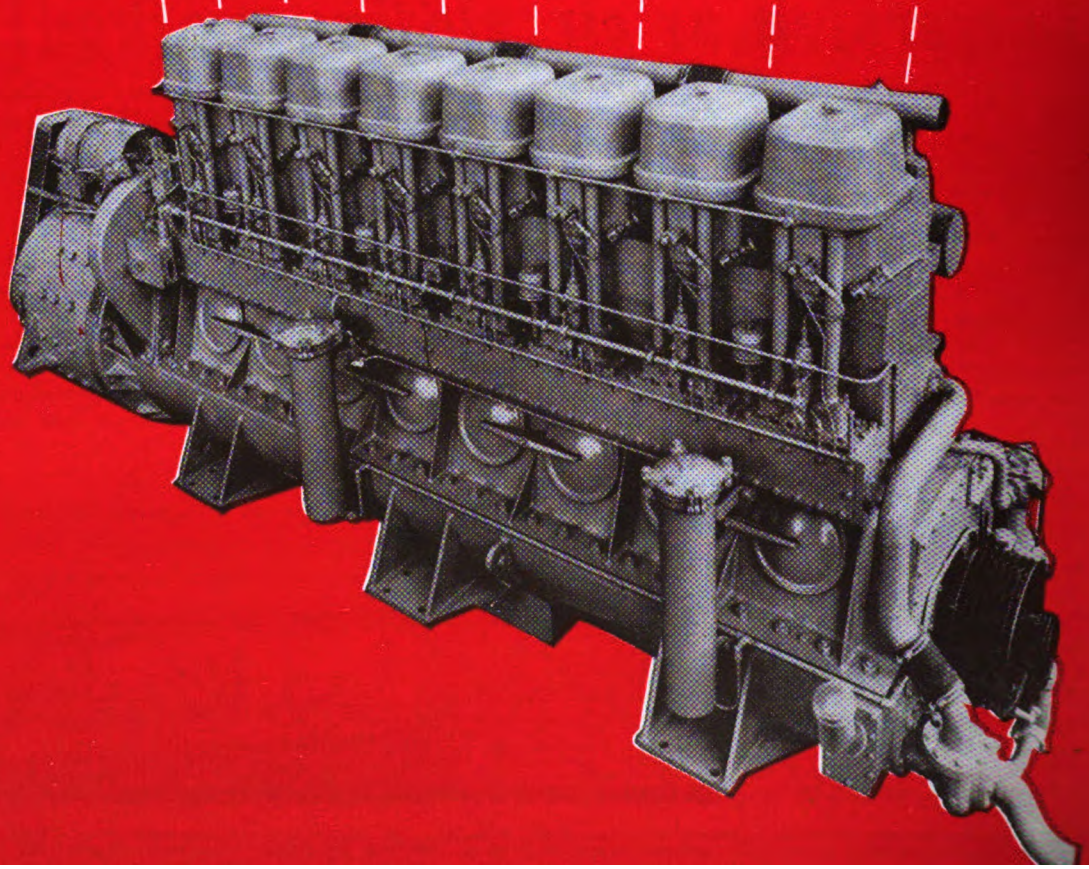
A thin shell of chrome plating adds thousands of dependable, trouble-free miles to the service between overhauls of Baldwin-Westinghouse Diesel-Electric Locomotives.

Users have reported that this "armor" has increased liner life four times and more, and eliminated many ring difficulties. This is just another of the many features that give these diesel-electrics their reputation for high availability, low operating cost, and top-notch performance. Write for details.



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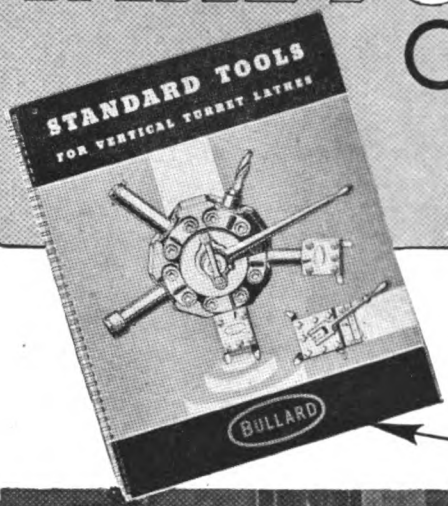

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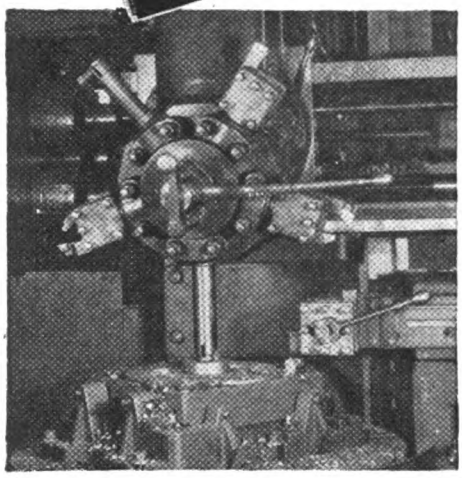

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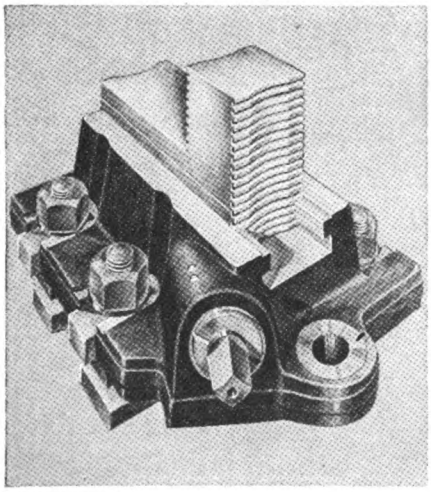

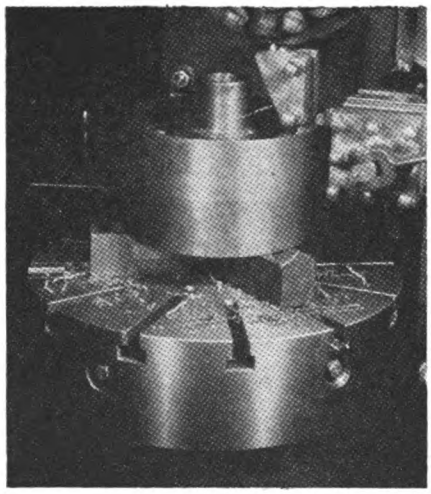

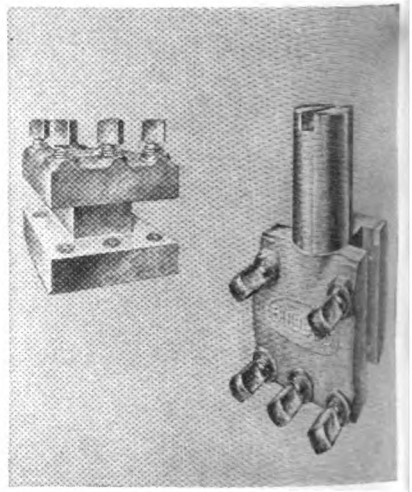

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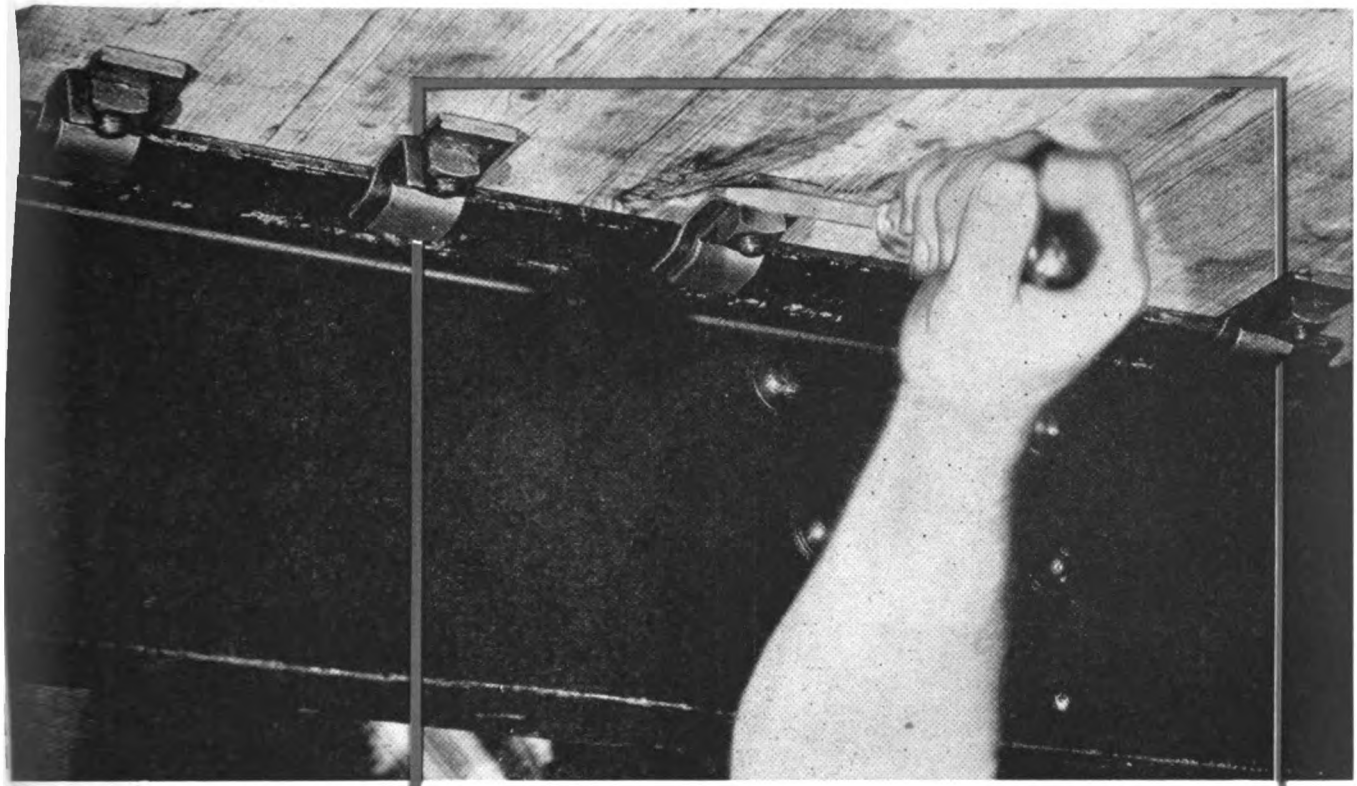

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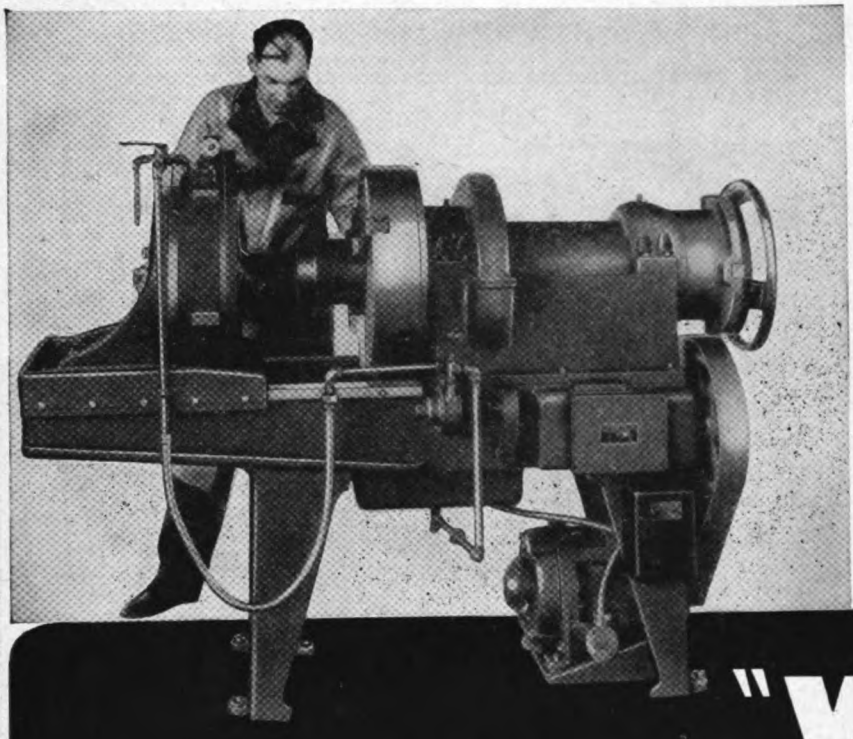

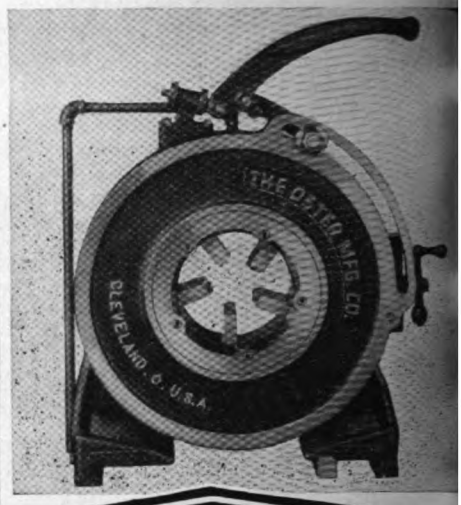

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Pipe Size	*Threading Time*
1″	16 seconds
1¼″	16 seconds
1½″	24 seconds
2″	25 seconds
2½″	38 seconds
3″	40 seconds
3½″	56 seconds
4″	58 seconds

No. 706 "WILCO"

Pipe Size	*Threading Time*
1½″	19 seconds
2″	20 seconds
2½″	30 seconds
3″	31 seconds
3½″	48 seconds
4″	49 seconds
5″	70 seconds
6″	74 seconds

Note: Above time studies based on cutting full American National Standard pipe threads at recommended speeds.

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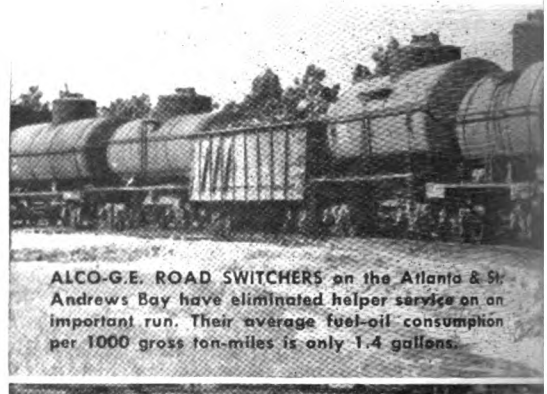
On one road, the all-purpose usefulness of four of these combination units was responsible for the release of seven steam locomotives and the speeding up of freight schedules —despite heavily increased traffic. On another road, where three of these units are assigned to switching work between road trips, annual gross savings amount to more than $90,000—a 33 per-cent return on the investment.

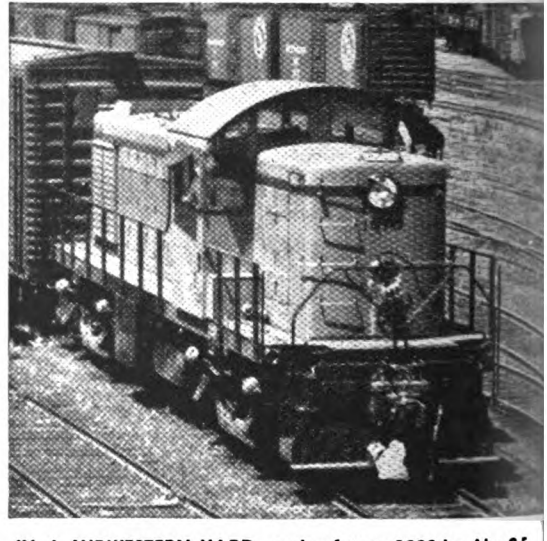
For switching, you'll find that it is equipped to give full power at all speeds, that it has almost unlimited visibility, and the built-in reliability that's characteristic of all Alco-G.E. diesel-electrics. It meets road requirements because it has the additional features of space for train-heating facilities, speed up to 60 mph, and the riding qualities of spring-supported, swing-bolster trucks having ample distance between centers for flexibility.

Because you can assign this diesel-electric to switching during the night and meeting road schedules during the day, you can realize a higher net return on your investment than you can from a single-purpose locomotive. Moreover, it has the greatest opportunity to effect the savings you'll need to meet the severe competition for postwar traffic.

Whether your plans to meet this competition call for diesel-electric, electric, or steam locomotives, we invite you to call in our engineers to work with your own on a motive-power survey. Their recommendations will be impartial—we build all three types of motive power.



ALCO-G.E. ROAD SWITCHERS on the Atlanta & St. Andrews Bay have eliminated helper service on an important run. Their average fuel-oil consumption per 1000 gross ton-miles is only 1.4 gallons.



IN A MIDWESTERN YARD, each of two 1000-hp Alco-G.E. units handled as many cars in 24 hours as released motive power handled in 28 hours.

Rock Island

On a 498-mile section of the Rock Island, four road switchers do the complete job—switching, accumulating trains, and hauling them on the road.

Kansas City So.

Four of these 1000-hp units on the Kansas City Southern are reducing fuel costs and speeding freight movements by cutting terminal-operation time.

Alco

GE

AMERICAN LOCOMOTIVE and

HOW ONE ROAD UTILIZES THE VERSATILITY OF ALCO-G.E. ROAD SWITCHERS

● On a southern line where two 1000-hp Alco-G.E. road switchers are doing double duty—road work and switching—there has been no need for additional motive power despite a 100 per-cent increase in traffic since they were placed in service. Their versatility enables this road to keep them busy at least 18 hours a day producing monthly savings of $3787 in road service and $3776 in switching.

***6:30 P.M. to 4 A.M.*—both locomotives, in tandem, haul 3200-ton trains over the one per-cent ruling grade of a 182-mile daily round-trip run.**

***4 A.M. to 3 P.M.*—one of the locomotives handles local switching, and transfer work between the road's terminals and a connecting railroad.**

***9 A.M. to 5 P.M.*—In addition to switching work at one of the yards, the other locomotive speeds passenger trains to a local resort during the summer.**

Alaska

At nearly passenger-train speeds, two of these Alaska Railroad units are hauling combined freight and passenger trains where two separate trains were formerly required.

Susquehanna

On the Susquehanna, four of these versatile units are making substantial reductions in operating cost. Their daily inspection and refueling takes 20 minutes.

GENERAL ELECTRIC

113-124-9580

GOVERNMENT SURPLUS

MACHINE TOOLS and PRODUCTION EQUIPMENT

CAN HELP YOU RECONVERT!

Government-owned Machine Tools and Industrial Equipment are available now to help industry shoulder the reconversion load.

It is the responsibility of the Reconstruction Finance Corporation to dispose of these surpluses as soon as possible—to turn them over to private industry, where they'll do the greatest good for the most people in the shortest time.

Therefore, in order to speed reconversion by getting this equipment into the hands of skilled craftsmen, faster .... we ask you to follow this simple procedure:

1. **Submit in writing your requirements for machine tools and industrial equipment to us *now*.**
2. **Send a typewritten list to your nearest R.F.C. Regional Office listed below.**
3. **Make your descriptions brief, one line if possible, clearly grouping various types of equipment you need.**

The supply of surplus tools is sufficient to meet all of the needs of industry, and in the event that your local R.F.C. Regional Office cannot fill your specific requirements, it will endeavor to locate needed equipment from other offices throughout the country.

First step in creating jobs is getting machines in motion faster.

The 31 strategically located agencies below are ready to make your reconversion problems easier.

RECONSTRUCTION FINANCE CORPORATION

A DISPOSAL AGENCY DESIGNATED BY THE SURPLUS PROPERTY ADMINISTRATION

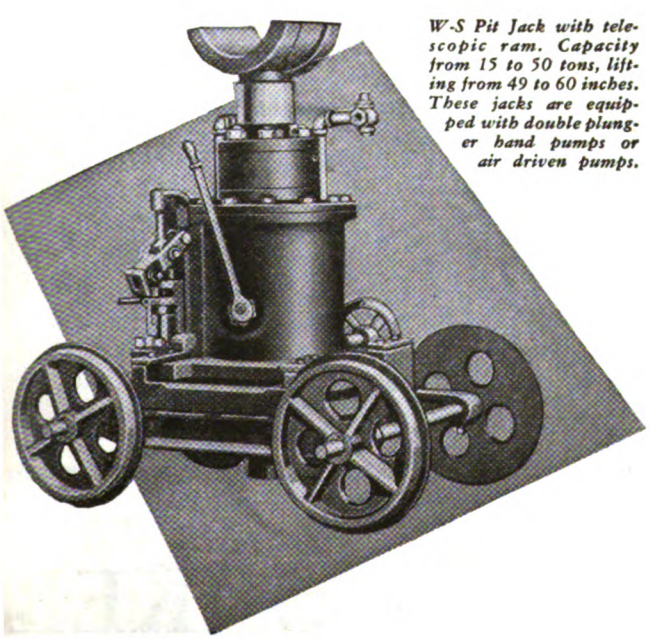
Agencies located at: Atlanta • Birmingham • Boston • Charlotte • Chicago • Cleveland • Dallas • Denver Detroit • Helena • Houston • Jacksonville • Kansas City, Mo. • Little Rock • Los Angeles • Louisville Minneapolis • Nashville • New Orleans • New York • Oklahoma City • Omaha • Philadelphia Portland, Ore. • Richmond • St. Louis • Salt Lake City • San Antonio • San Francisco • Seattle • Spokane

104

With

W-S HYDRAULIC EQUIPMENT

In round house and repair shop, Watson-Stillman hydraulic equipment has been known for years, along with the part it plays in assuring quick, economical performance of vital work. Whether your needs call for straightening and bending presses . . . portable and stationary rail benders . . . jacks and pit jacks, the complete range of W-S hydraulic products answers many wartime requirements on regular jobs and in emergencies. These machines and equipment benefit by a distinctive background of engineering and hydraulic experience. Count on them to stand up under the increased work loads caused by troop movements and other essential transportation demanded by the nation. The Watson-Stillman Co., Roselle, N. J.



W-S Pit Jack with telescopic ram. Capacity from 15 to 50 tons, lifting from 49 to 60 inches. These jacks are equipped with double plunger hand pumps or air driven pumps.

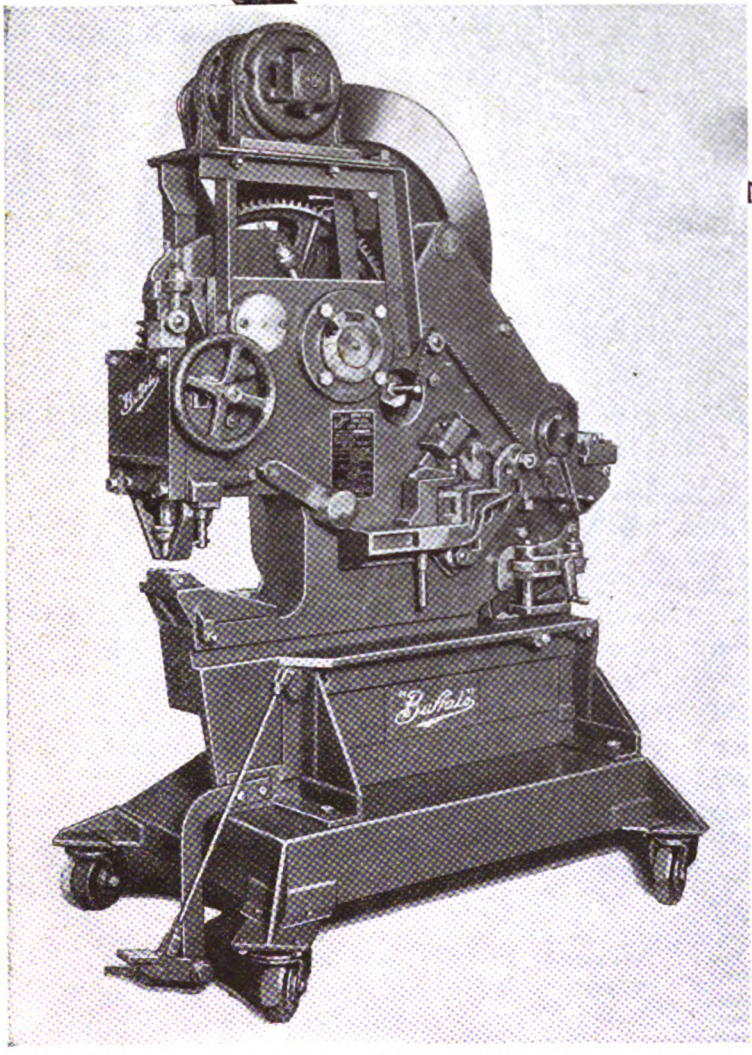
W-S PIT JACK

Watson-Stillman Pit Jacks are operated on the hydro-pneumatic principle and may be powered by either hand or air operated pumps. The jack with the telescopic ram, shown here, is most convenient for use in shallow pits. The cylinder is only half as long as in the plain type, thus providing a minimum height above the rails and eliminating the need for a sub-pit. Bulletin B-8 gives complete details and specifications of these jacks.

WATSON-STILLMAN

Designers and Manufacturers of Hydraulic Equipment, Forged Steel Fittings, and Valves

MAINTENANCE TOOL FOR PRODUCTION!



The punch capacities of "Buffalo" Universal Iron Workers range from 13/16" x 7/16" to 1¾" x 1½"; shear capacities are from ⅝" to 1½" plates.

Yes, maintenance can be put on a *production basis!* You can cut, punch, sheer, notch and cope steel plate, angles, tees, beams and other forms used in industrial maintenance *far faster* with "Buffalo" Universal Iron Workers. Thousands of these "Buffalo" huskies are turning out speedier, more economical jobs in repair work, new construction and straight production work . . . in railroads, steel mills, other heavy industries. "Buffalo" Universal Iron Workers are made in a wide range of sizes. The various tools may be operated at one time, and unskilled operators need little supervision. For full details, prices, write:

BUFFALO FORGE COMPANY
174 Mortimer Street, Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

UNIVERSAL IRON WORKER

WHY SPEED NUTS ARE FIRST

with Time Study and Cost Departments

When ALL assembly costs are down in black and white... when TOTAL net assembly costs are figured... that's when SPEED NUTS really show results in the Cost Department.

For SPEED NUTS reduce assembly costs in many ways. They completely eliminate lock washers—saving the cost of the washers *and* the time necessary to handle and install them. Moreover, hundreds of SPEED NUTS have been designed to perform multiple functions and eliminate two or more assembly parts.

SPEED NUTS are applied faster and easier to speed up assembly. They can't "clog" with paint or enamel to delay the assembly line. "Self-retaining" types of SPEED NUTS do away with expensive welding and clinching operations. And SPEED NUT spring-tension resiliency also protects porcelain, plastic or glass parts against damage in transit.

A letter describing your fastening problem will bring you full details on how SPEED NUTS will reduce YOUR total net assembly costs, too.

NOTHING LOCKS LIKE A SPEED NUT

Only SPEED NUTS provide a COMPENSATING thread lock and a SELF-ENERGIZING spring lock. As the screw is tightened the two arched prongs move inward to lock against the root of the screw thread. These free-acting prongs COMPENSATE for tolerance variations. Compression of the arch in prongs and base creates a SELF-ENERGIZING spring lock. These two forces combine to definitely prevent vibration loosening.

TINNERMAN PRODUCTS, INC.• 2029 Fulton Road, Cleveland 13, Ohio

In Canada: Wallace Barnes Co., Ltd., Hamilton, Ontario
In France: Aerocessoires Simmonds, S. A., Paris

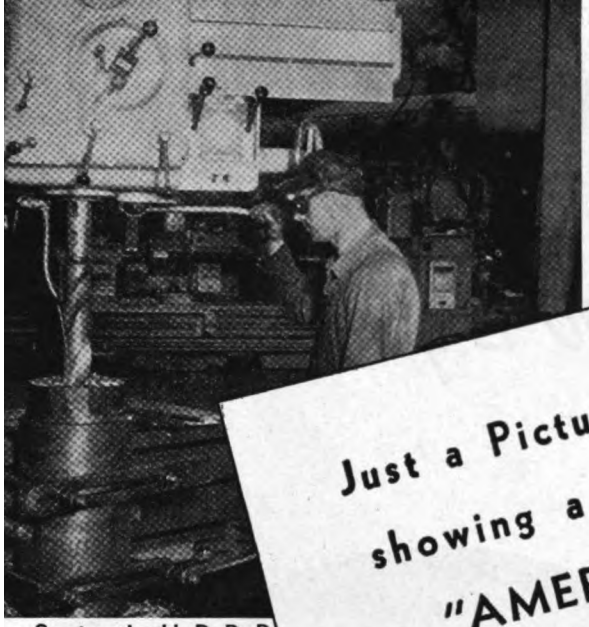
In England: Simmonds Aerocessories, Ltd., London
In Australia: Simmonds Aerocessories, Pty. Ltd., Melbourne

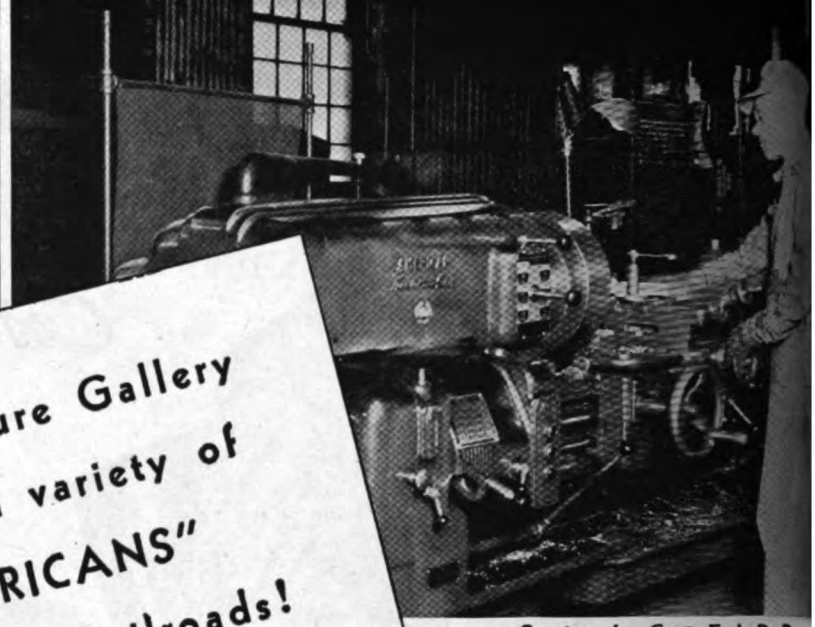
Speed Nuts*

PATENTED

* Trade Mark Reg. U. S. Pat. Off.

FASTEST THING IN FASTENINGS...OVER 3000 SHAPES AND SIZES

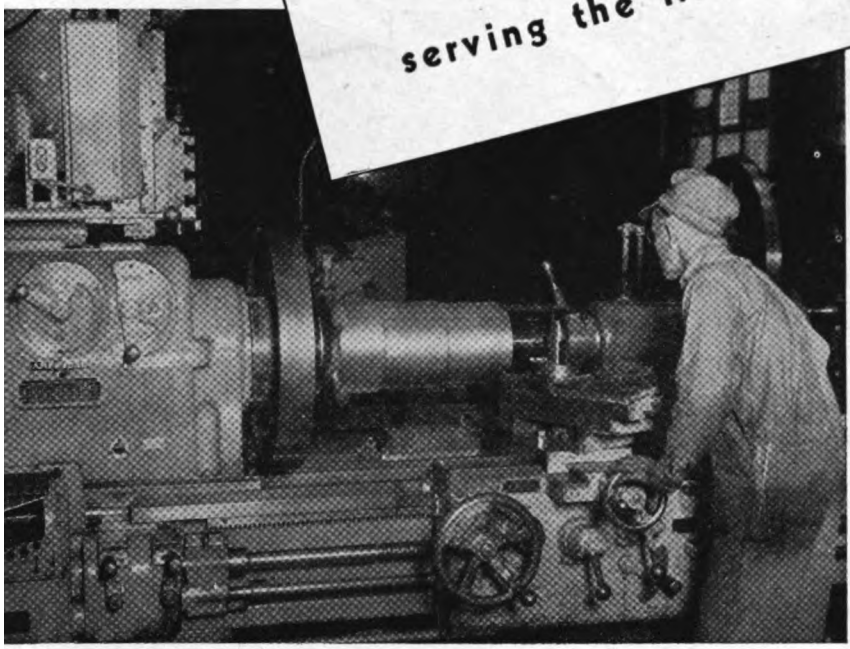


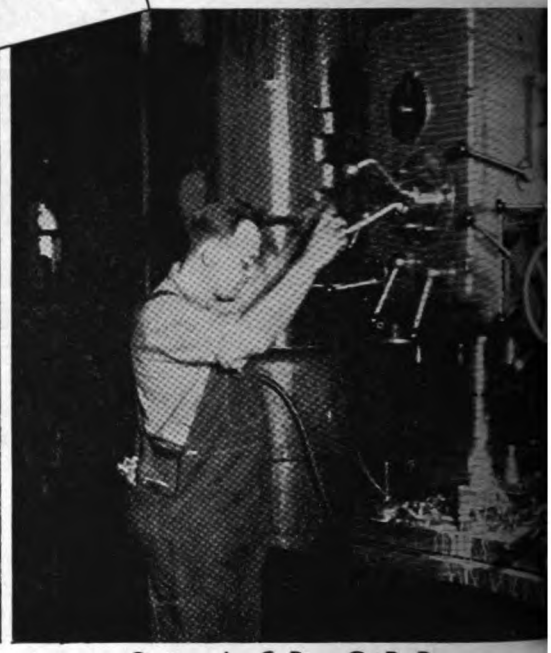


Just a Picture Gallery showing a variety of "AMERICANS" serving the Railroads!

• Serving the U. P. R. R.

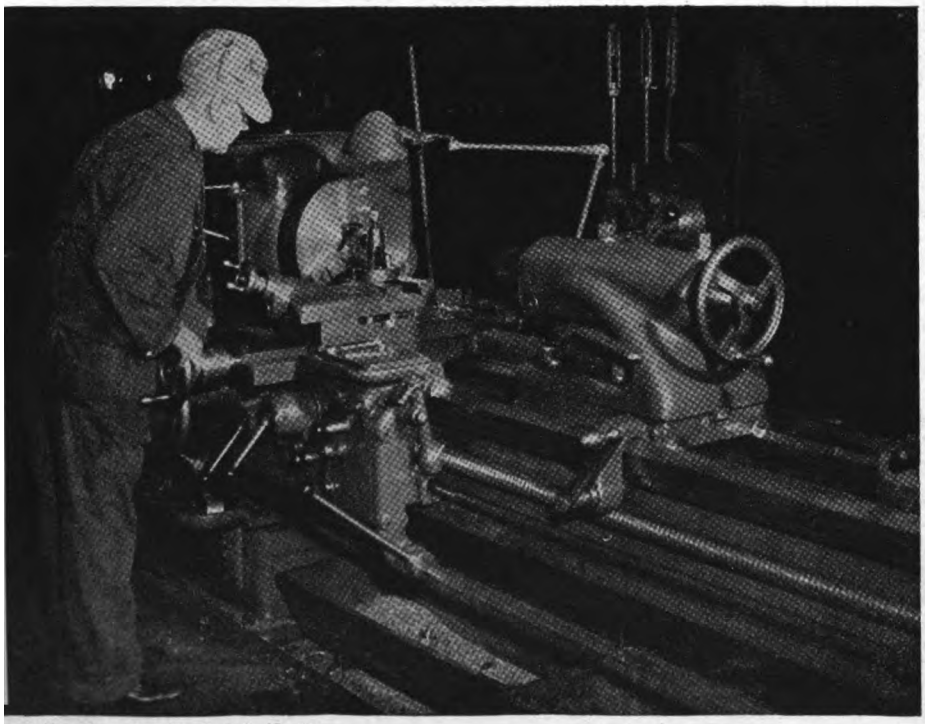
• Serving the C. & E. I. R. R.

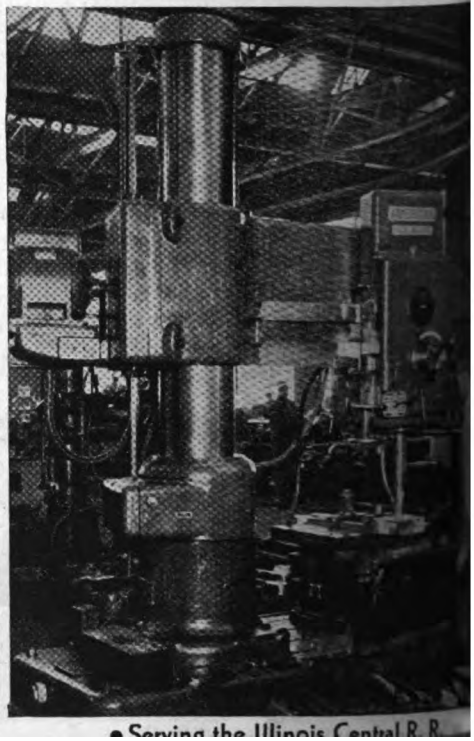




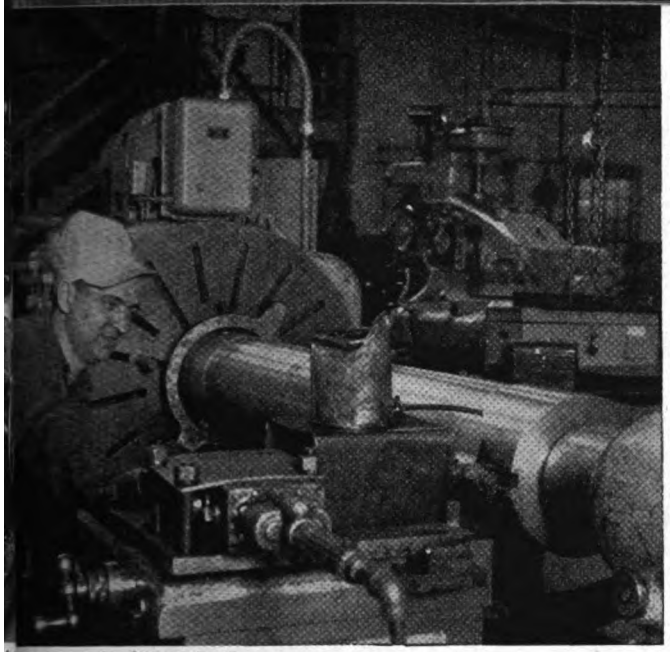
• Serving the U. P. R. R.

• Serving the C. B. & Q. R. R.

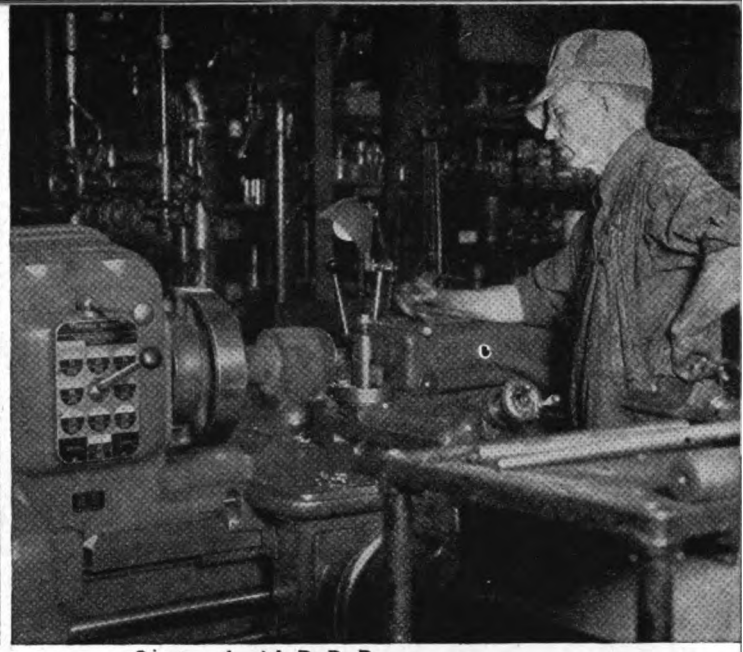




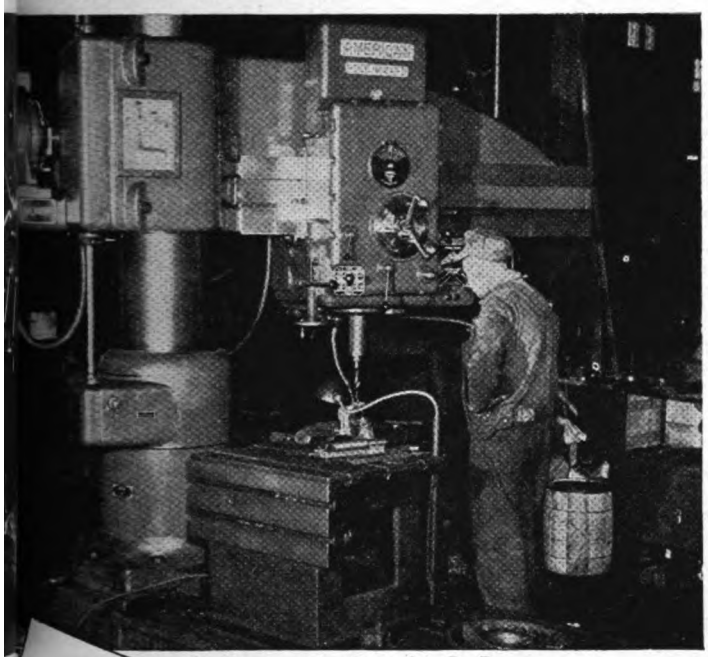
• Serving the Illinois Central R. R.



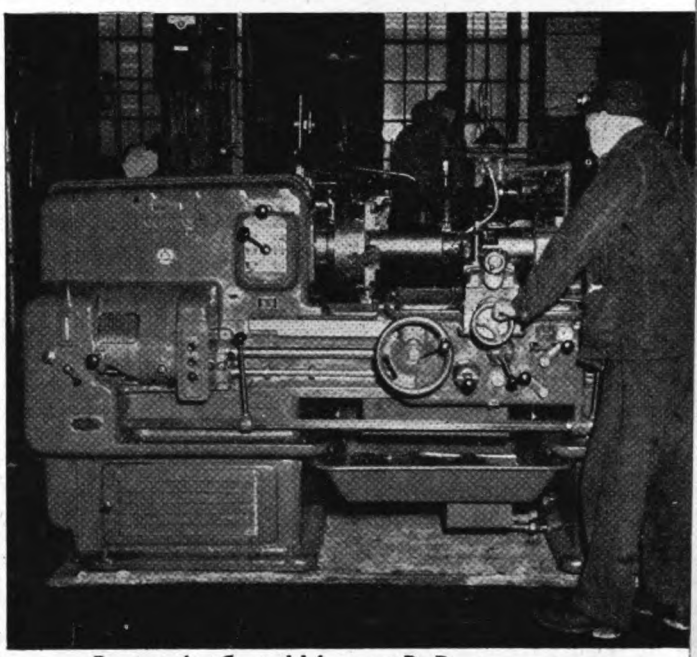
• Serving the U. P. R. R.



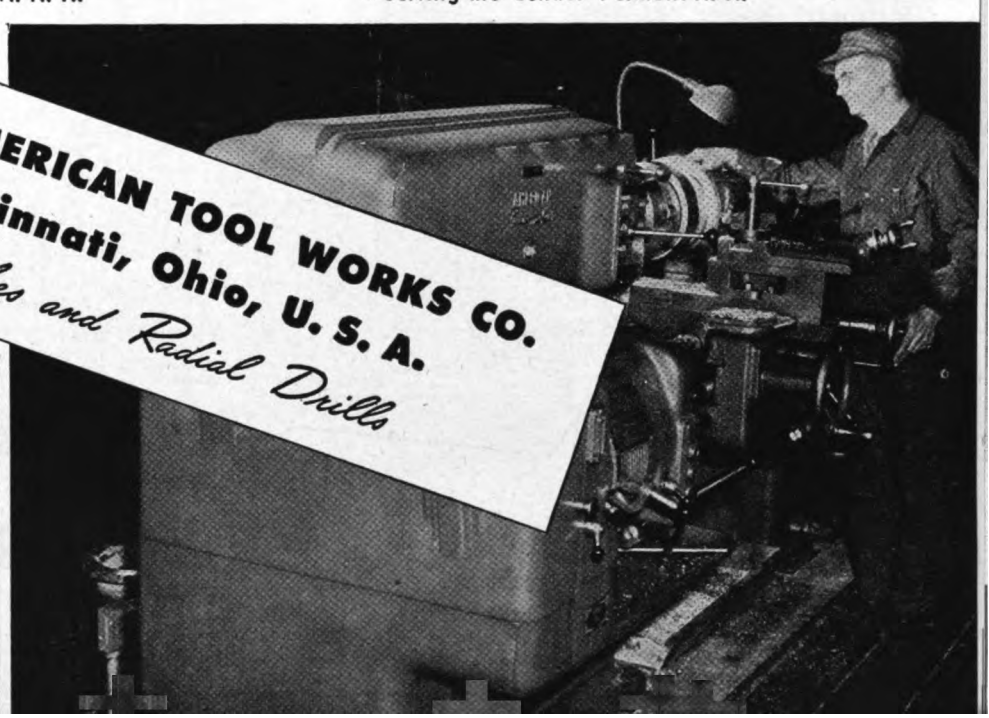
• Serving the N. P. R. R.



• Serving the B. & M. R. R.



• Serving the Central Vermont R. R.



THE AMERICAN TOOL WORKS CO.
Cincinnati, Ohio, U. S. A.
Lathes and Radial Drills

215 INDIVIDUAL OPERATIONS MADE

No Prior Work Layout Required—Machining Simplified

■ Twenty-four surfaces are milled, 100 holes are drilled, 37 bored, 35 tapped, 10 reamed, 8 faced and one counterbored on a planer type G. & L. machine to complete this huge revolving frame for final assembly. All operations are performed in only three settings.

Machine scales and verniers are depended upon entirely to locate all dimensions which are held to .002" between bore centers and on pad faces. *No preliminary layout work is required.* The massive weldment is taken directly to the G. & L. machine after fabrication and is mounted on the table for machining operations.

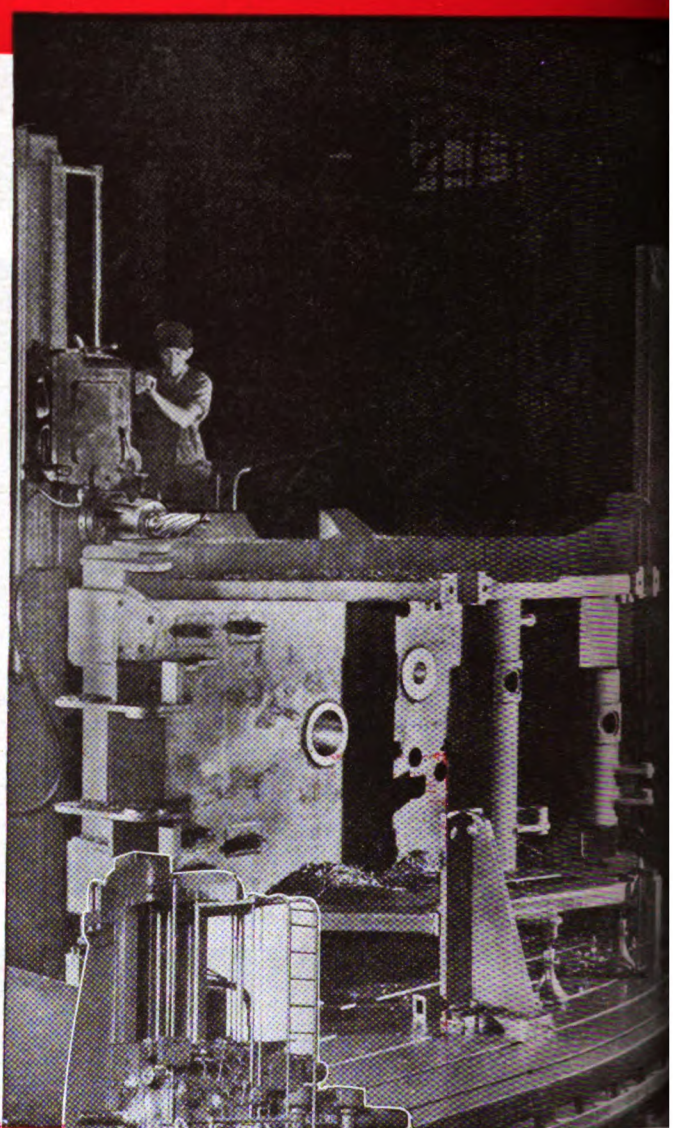
PROFILING USED TO MACHINE CIRCULAR PAD

G. & L. headstock and table feeds used in combination make it possible to profile the circular roller path without difficulty. Headstock feed is engaged simultaneously with table feed. As a result of this compound feed movement, the cutter mills the circular path of the roller pad to the required dimensions.

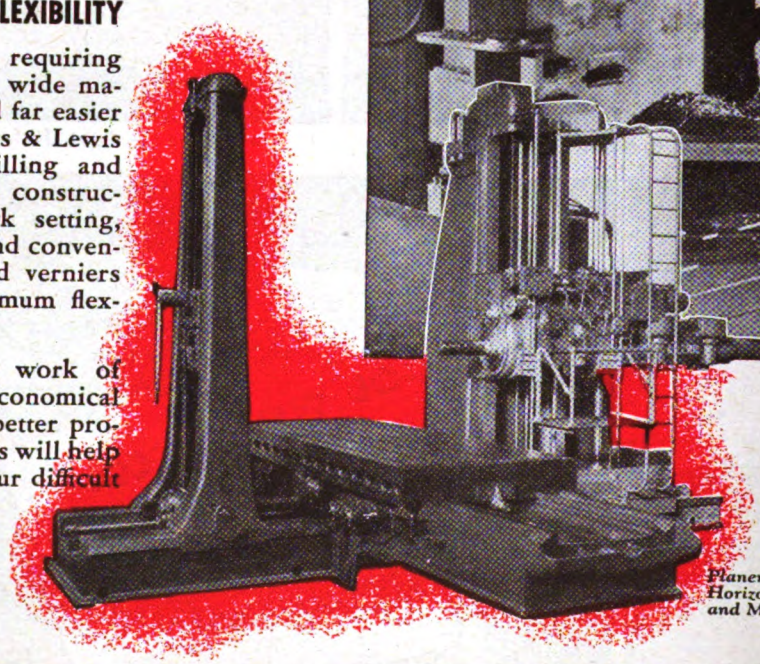
MAXIMUM MACHINE FLEXIBILITY

Large complex work requiring multiple operations and wide machining range is handled far easier and better on a Giddings & Lewis Horizontal Boring, Drilling and Milling Machine. Open construction, simplicity of work setting, accuracy of operations and conveniently located scales and verniers give this machine maximum flexibility and versatility.

If you are producing work of this kind and seek an economical and practical means to better production, G. & L. engineers will help you analyze and solve your difficult machining problems.



Giddings & Lewis 360-P Planer Type Machine with work mounted on table.



Planer Type Giddings & Lewis Horizontal Boring, Drilling and Milling Machine.

GIDDINGS & LEWIS

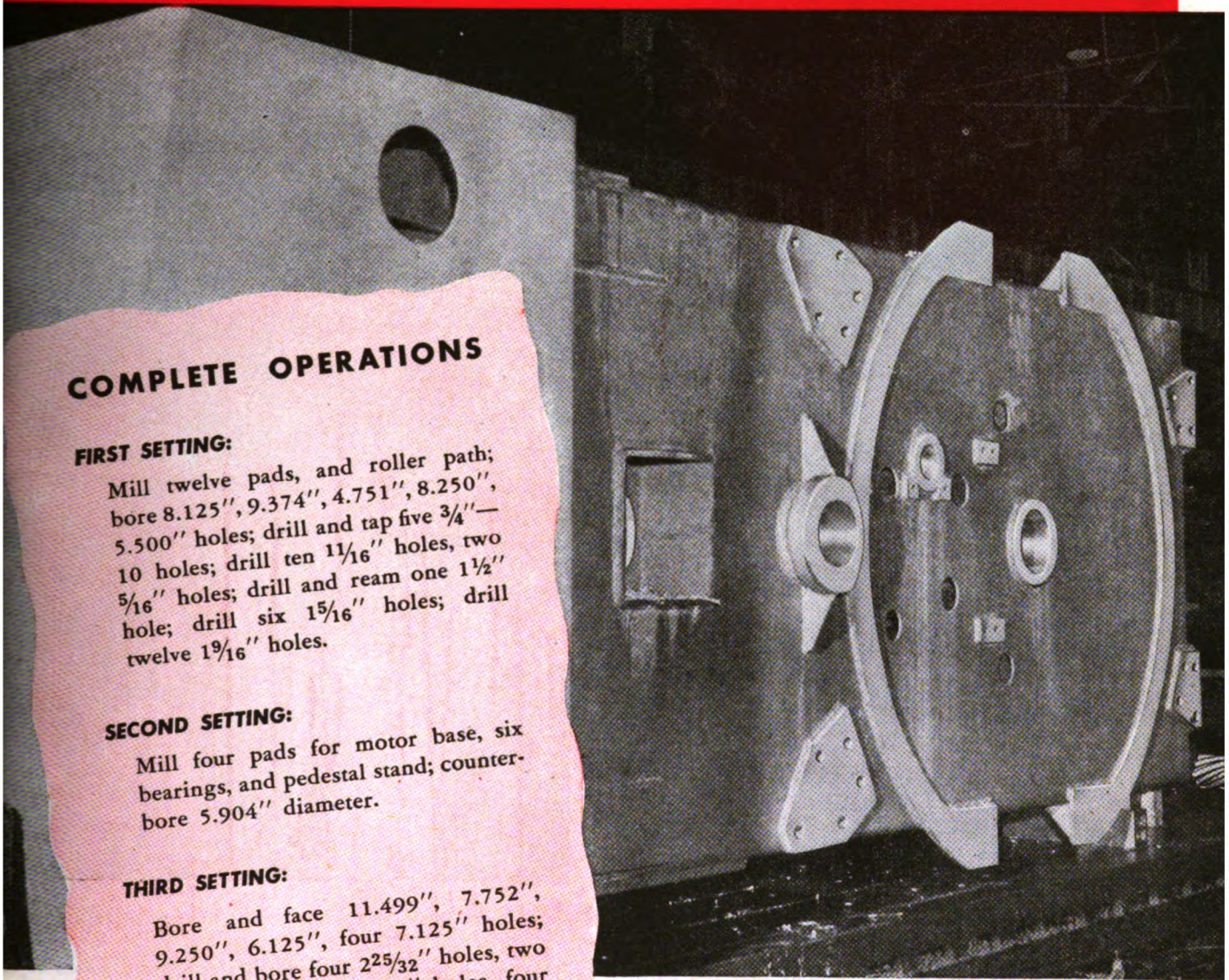
150 DOTY STREET

Right: G. & L. Table

Right: G. & L. Floor

3 SIMPLE SETTINGS OF THIS HUGE FRAME

G.&L. Scales and Verniers Permit Work Within the .002" Limits Required



COMPLETE OPERATIONS

FIRST SETTING:

Mill twelve pads, and roller path; bore 8.125", 9.374", 4.751", 8.250", 5.500" holes; drill and tap five 3/4"—10 holes; drill ten 11/16" holes, two 5/16" holes; drill and ream one 1½" hole; drill six 15/16" holes; drill twelve 19/16" holes.

SECOND SETTING:

Mill four pads for motor base, six bearings, and pedestal stand; counterbore 5.904" diameter.

THIRD SETTING:

Bore and face 11.499", 7.752", 9.250", 6.125", four 7.125" holes; drill and bore four 2 25/32" holes, two 2 1/32" holes, six 1.752" holes, four 2.002" holes; drill and ream 1.499" hole; drill, bore and ream two 2.450" holes, six 2.937" holes; drill and tap thirty 5/8"—11 holes; and drill nine 23/32" holes.

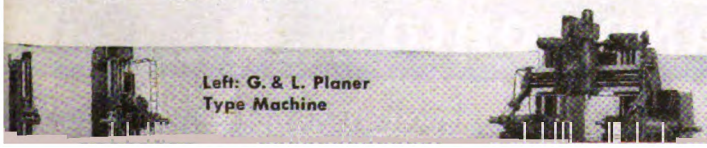
Revolving Top Frame for Excavator in first work position.

FREE Field Production Facts

will help you solve difficult machining problems. Write today for your copy of Trade Journal Advertising RM150, covering advanced G.&L. machining methods. Please indicate your business connection.

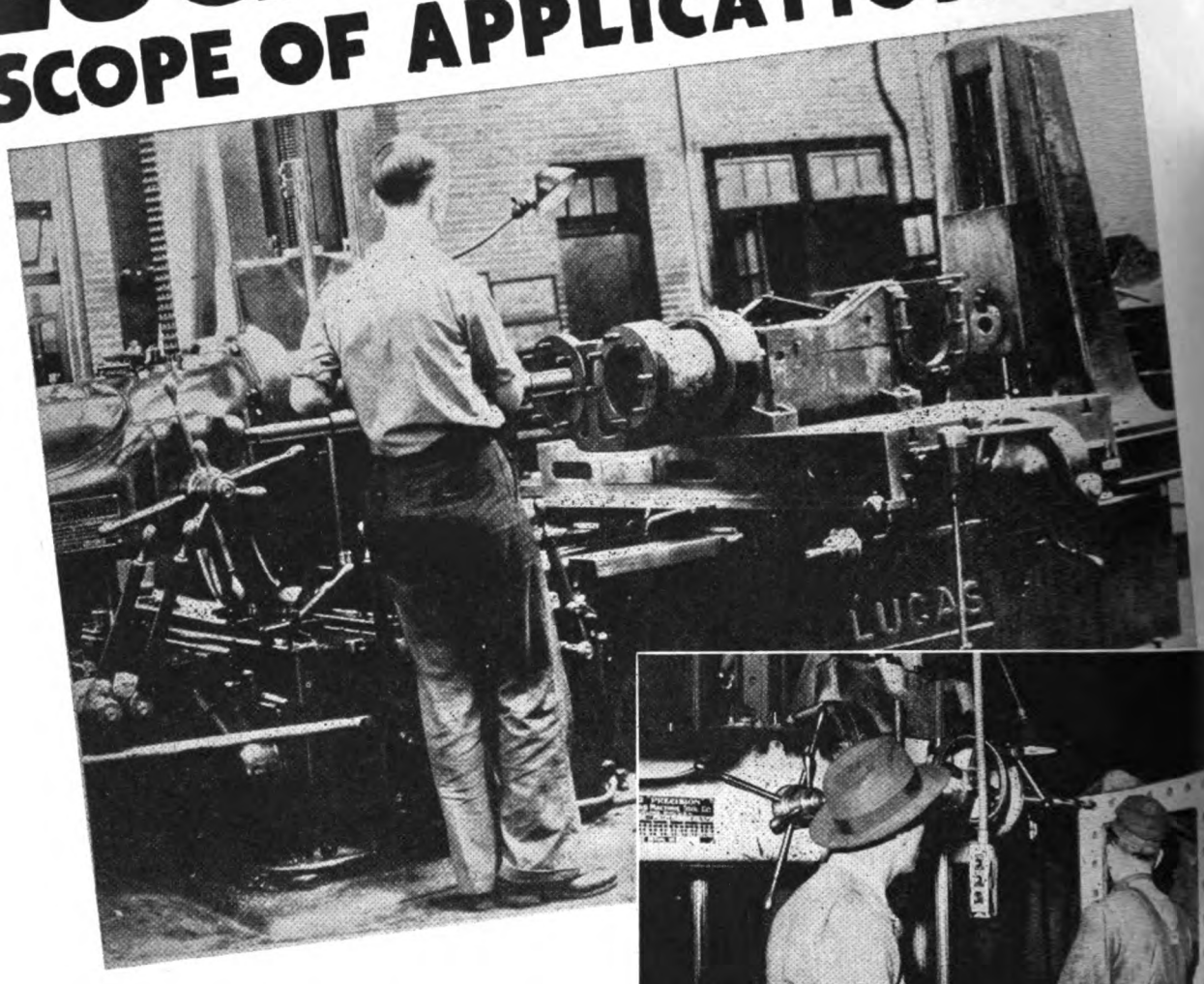
MACHINE TOOL CO.

FOND DU LAC, WIS.



Left: G. & L. Planer Type Machine

LUCAS "PRECISION" SCOPE OF APPLICATION



INDISPENSABLE IN A LOCOMOTIVE SHOP . .

DUE to its design, it is obvious that the LUCAS Horizontal Boring, Drilling and Milling machine is a general purpose tool. Its cost-saving scope of application covers so many jobs that many railroad shop foremen claim it is indispensable.

The biggest savings effected are on large and cumbersome parts that require several operations which are difficult to handle on any other unit, but simple to set up and machine on a Lucas.

These parts include stokers, feedwater heaters, power reverse gears, coal pushers, dry pipes, one-piece truck frames and many other components.

Upper illustration shows a LUCAS boring a stoker engine cylinder — the cylinders did not have to be removed from the bed. Bottom view shows a recent installation drilling holes in a heavy Mallet type bumper and supporting bracket. Yes! You can always keep a LUCAS saving money in your shop.

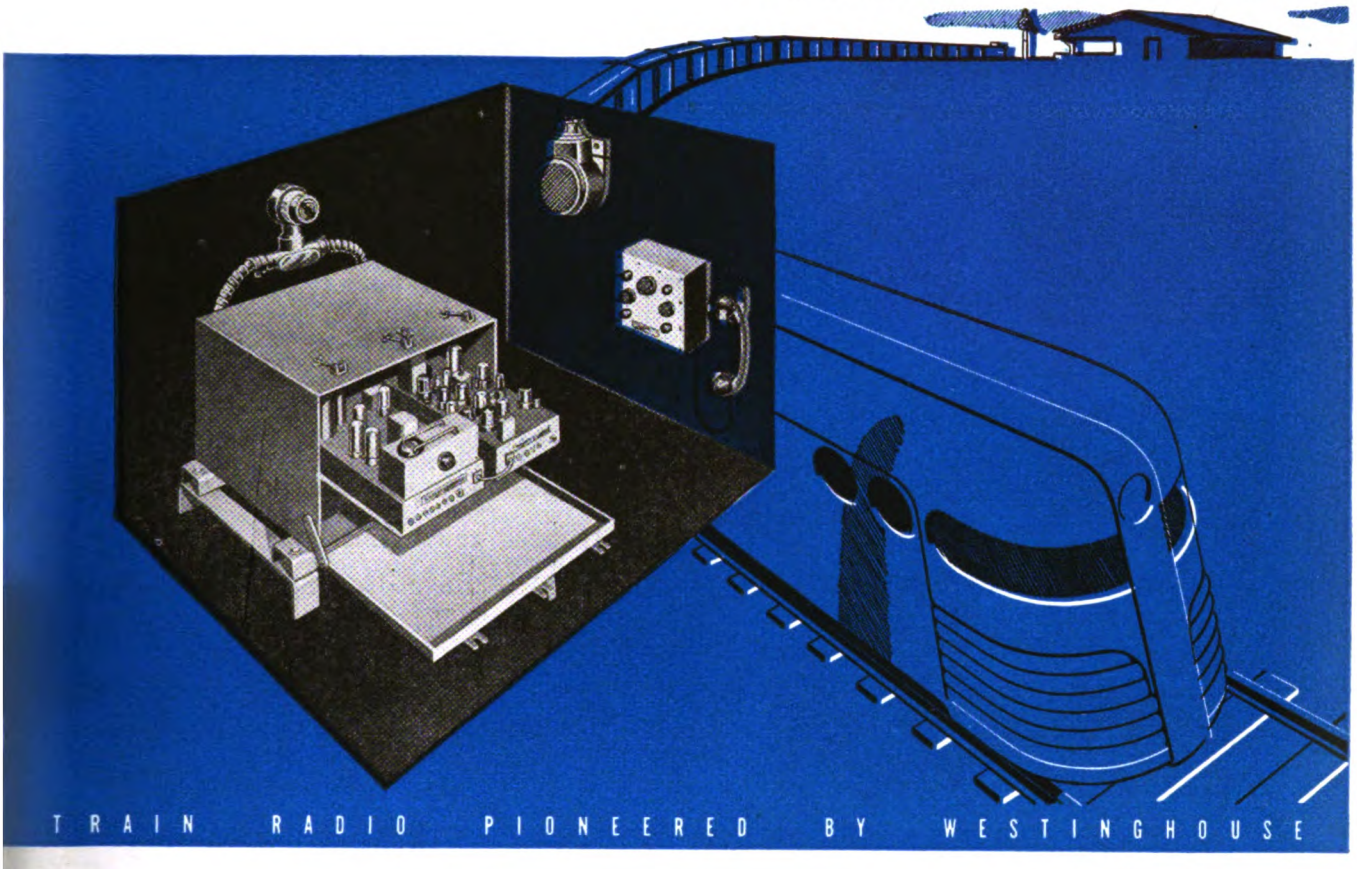
LUCAS MACHINE TOOL CO.

CLEVELAND, OHIO

Westinghouse builds

Train radio for the Railroads

. . . since 1925



Westinghouse's vast experience in railroad electrical equipment is now applied to building space radios designed *specifically for railroad* operation.

Westinghouse engineers have proved their ability to design sturdy equipment to meet the toughest handling and severest weather conditions.

This new transportation development attains reliable communication between wayside station and train . . . train to train . . . engineer to caboose.

The unmatched experience of Westinghouse in Train Radio since 1925 is a logical reason for consulting Westinghouse to aid in your communication problems. Write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-95108

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

FOR OVER 60 YEARS THE BEST KNOWN NAME IN RAILROAD ELECTRICAL EQUIPMENT

READY NOW FOR STEAM DIESEL ELECTRIC OPERATION

OTISCOLOY PLATES

AND

OTISCOLOY SHAPES

Today's trend toward maximum structural strength with minimum structural weight brings into prominence Otiscoloy, J & L's lightweight steel of high tensile strength that affords long wear and service. Otiscoloy is adaptable to hot and cold working, is as readily weldable as low carbon steels, resists corrosion and abrasion, is available in Plates, Sheets, Light Weight Channels, Junior Beams, Junior Tees, Angles, Bars and Jal-Tread Floor Plate.

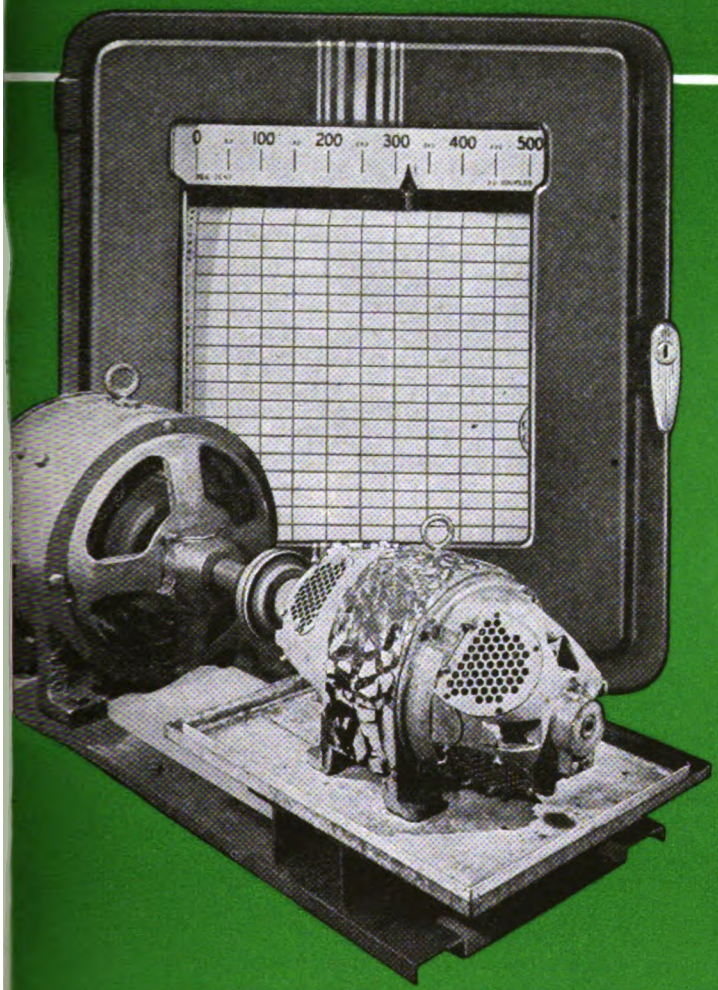
JONES & LAUGHLIN STEEL CORPORATION

PITTSBURGH 30, PENNSYLVANIA

J&L STEEL

DOW CORNING

SILICONES increase permissible operating temperatures by more than 100°C.



Today many accepted engineering limitations are being swept away by revolutionary new Dow Corning silicone materials. Designers are making major product improvements—coupled with important economies—never before possible.

Here's a specific example. Dow Corning varnishes and resins—because of their unique resistance to high temperatures—make it possible to redesign or rewind electrical equipment for increased horsepower output per unit weight. At the same time they greatly prolong equipment life under adverse operating conditions and reduce overload failures and fire hazards.

The recent development of DC 996, a Silicone Varnish which cures at 300°F., enables any electrical maintenance or rewind shop to secure the greater operating economies of Silicone Insulation.

In other industries Silicone materials also make possible operations which were previously impossible or very expensive. Consult Dow Corning for particulars.

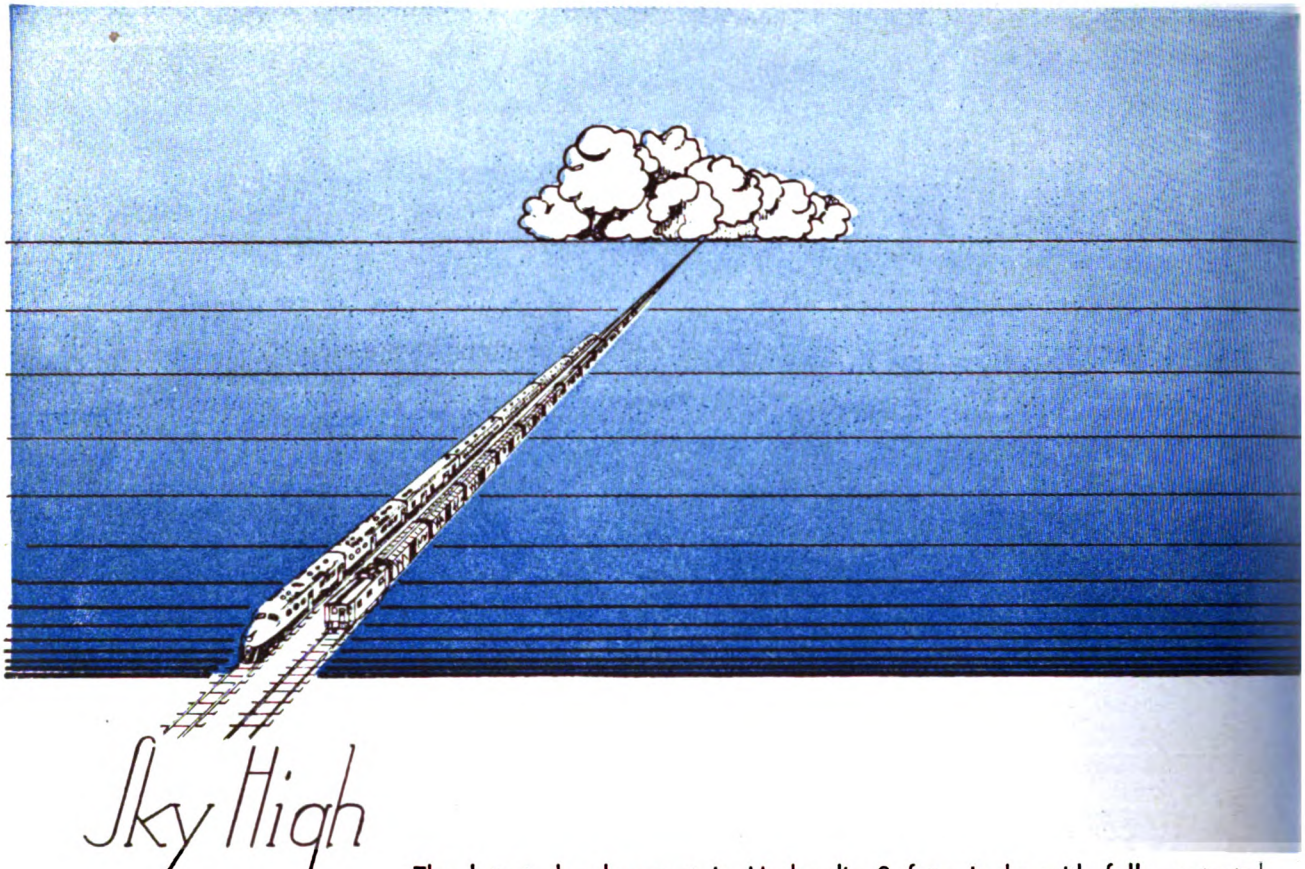
IN THE ELECTRICAL INDUSTRY, FOR EXAMPLE

This test motor wound with Silicone Insulation has been alternately saturated with moisture and operated at 310°C. (590°F.) by resistance, for a total of 2,000 hours with no sign of failure. Silicone Insulation means reliable and continuous operation under most adverse conditions.

DOW CORNING CORPORATION
MIDLAND, MICHIGAN
NEW YORK OFFICE: EMPIRE STATE BUILDING

Dow Corning

FIRST IN SILICONES



Sky High

The latest development in Hydraulic Safety Jacks with fully patented "Quick Contact" for all lifting, hoisting, pushing and pulling jobs in the maintenance of locomotives and cars.

Sky High Hydraulic Jacks and tools embody the best features of modern hydraulic principles especially adapted to Railroad Mechanical Department Tools.

***Sky High* will include:**

- **Hydraulic Draft Gear Tools—for installing and removing draft gear in passenger and freight cars.**
- **Hydraulic Hoist for Heavy Parts—to install or remove quickly, heavy parts and fixtures beneath locomotives and cars.**
- **Portable Rams, Operated by Separate Pumps—for use in close quarters, equalizer spring jobs, car straightening, etc.**
- **Hydraulic "Quick Contact" Safety Jacks—for locomotives, cars, etc.**
- **Hydraulic "Quick Contact" Binder Pushers—for rapid and safe installations of Locomotive Binders, etc.**
- **All Actuating Parts Enclosed—affording longer life through protection of vital parts against foreign matter and damage in use and handling.**

Years of experience in design, engineering, and production of many hydraulic units for installation in aircraft as well as for their service and maintenance is your assurance that United Aircraft Products, Inc. will make available to you exceptional hydraulic products and provide engineering counsel in the helpful solution of your problems. Distribution of Sky High Hydraulic Products is "just around the corner." Watch for early announcement.

UNITED AIRCRAFT PRODUCTS, INC.

RAILROAD TOOL MFG. DIVISION

SKY HIGH

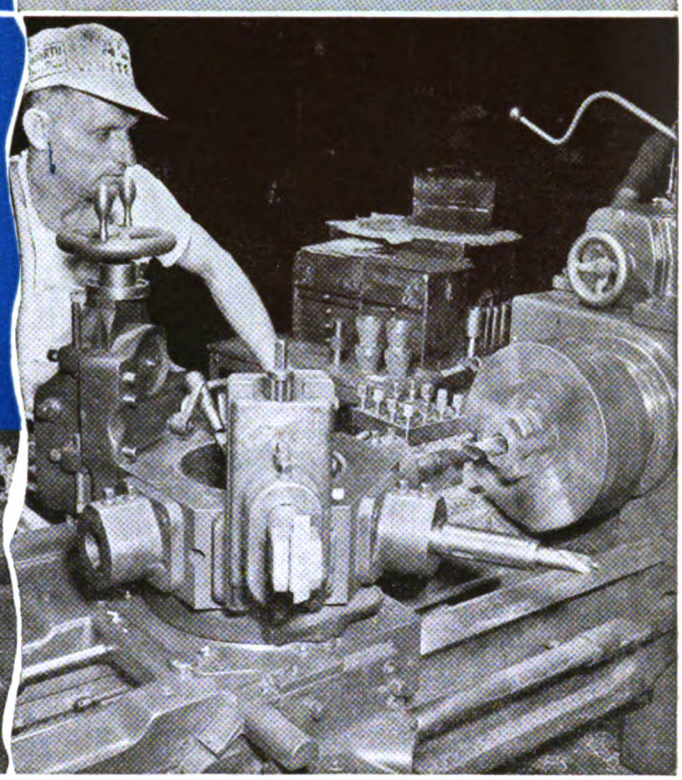
2929 SANTA FE AVENUE
LOS ANGELES 11, CALIFORNIA

GENERAL OFFICES: DAYTON, OHIO

UAP

The Problem: SMALL LOT RUNS

The Answer: WARNER & SWASEYS!



RIGHT now, a great many plants are finding production demands changing from long to short runs, with profitable operation more and more dependent on ability to shift equipment quickly from one job to another.

Five factors enter into profitable small run production:

1. Speed and ease of changeover—to keep set-up time low.
2. Flexibility in tooling—to cover the widest range of operations possible with one set-up.
3. Dependability—to hold close tolerances without time-wasting trouble-shooting.
4. Ease of operation—to speed job through.
5. Low maintenance costs—to cut overhead that must be charged against each job.

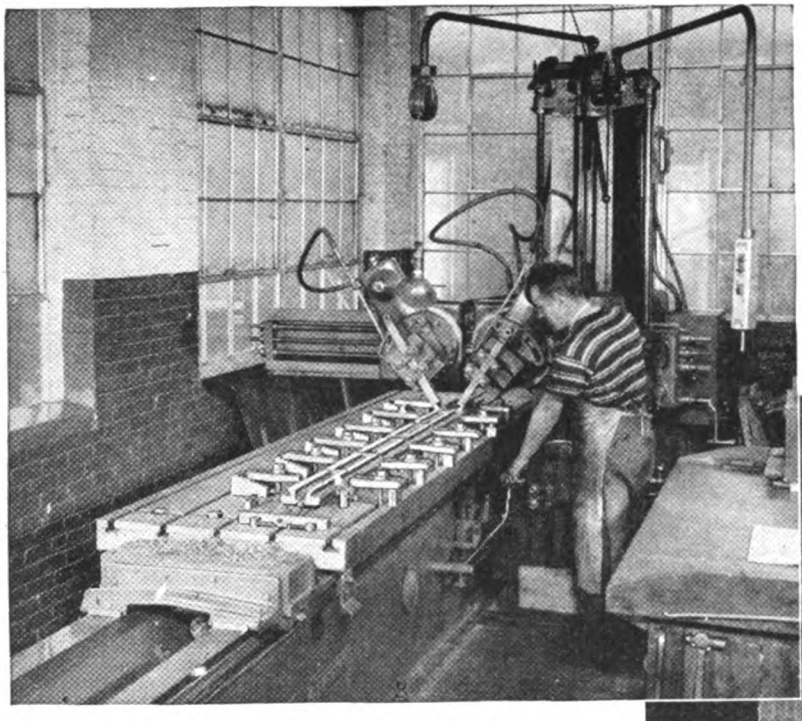
If you'll check up on your own experience with Warner & Swaseys—or the experiences of others—you'll find that they prove to be at or near the head of the list on every one of these five counts!

Why not let a Warner & Swasey Field Engineer show you how the quick adaptability of Warner & Swaseys provides the answer to the problem of maintaining profits in the days ahead. When you plan your equipment investment, look beyond the immediate job in hand—to years of low-cost profitable operation with multi-purpose Warner & Swaseys.

YOU CAN MACHINE IT BETTER, FASTER, FOR LESS . . . WITH A WARNER & SWASEY

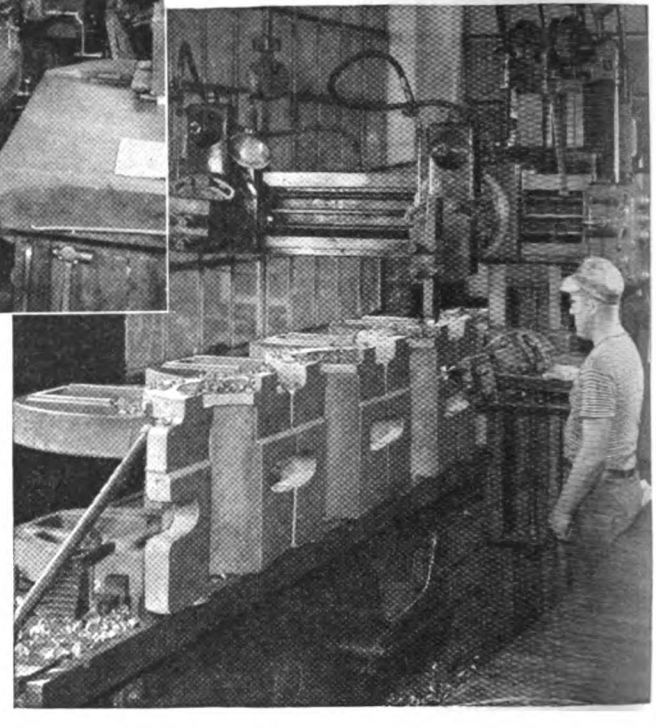
TURRET LATHES, SADDLE AND RAM TYPES — CHUCKING AND BAR TOOLS — PRECISION TAPPING AND THREADING MACHINES

WARNER & SWASEY
Machine Tools
Cleveland



Hy-Draulic

4518



Light Bite

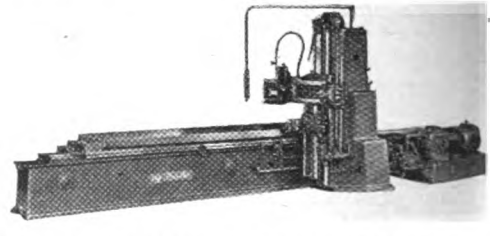
or a

Mouthful

Hy-Draulic Shaper-Planer Work Is ACCURATE • FAST • EASY

Handy, powerful, durable, the Hy-Draulic Shaper-Planer is particularly effective on pieces that are too big for large shapers yet too small for economical production on planers. Accurate, fast, easy to operate. It handles such a wide variety of work, light, medium and heavy, that it quickly becomes one of your most profitable investments. Investigate the advantages of hydraulic drive and feeds in the Rockford Hy-Draulic Shaper-Planer. Write, today, for Bulletin 1926.

- Above, left .... A 120" stroke Hy-Draulic Shaper-Planer, planing dovetails on cast-iron slides. Extra crossrail head reduces planing time.
- Above, right .... Same Shaper-Planer roughing a gang of cast steel steering gear parts. Note crossrail head and side head are both working on intermittent cuts.



ROCKFORD HY-DRAULIC SHAPER-PLANERS

Available in stroke-lengths of 42", 66", 90", 120" and 144". Hy-Draulic Shaper-Planer speeds and feeds are infinitely adjustable in specified ranges. Economical standard constant speed electric motor drives hydraulic unit.

ROCKFORD MACHINE TOOL CO., ROCKFORD, ILLINOIS

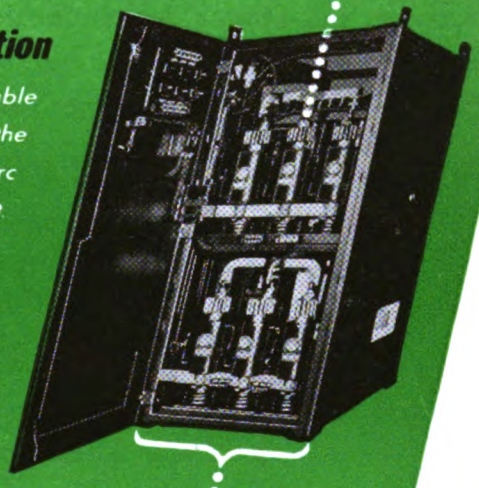
POWER CONVERSION

"Spark Plug"

Westinghouse IGNITRON Principle

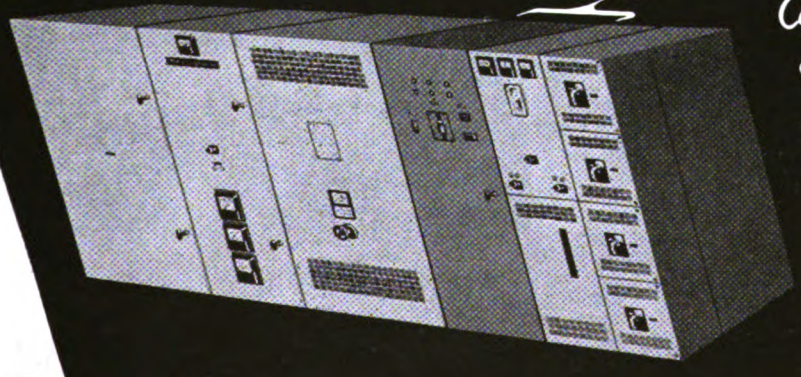
Heart of the IGNITRON Unit Substation

The Westinghouse Ignitron Principle provides a reliable method of starting an arc in a few micro-seconds, at the beginning of each conducting period and permits the arc to extinguish when the anode is not conducting current. This principle permits use of minimum shielding, thereby lowering arc losses. These inherently low losses provide remarkably high efficiency at low loads, as well as under heavy load conditions. The ignitron rectifier consists of the correct number tubes, for the required KW output. Each tube is complete with its anode, cathode and ignitors and is evacuated and permanently sealed at the factory



ASSURES CONTINUOUS SMOOTH FLOW OF CURRENT

CONSIDER ALL ADVANTAGES OF POWER CONVERSION AT ITS BEST



Consult Westinghouse

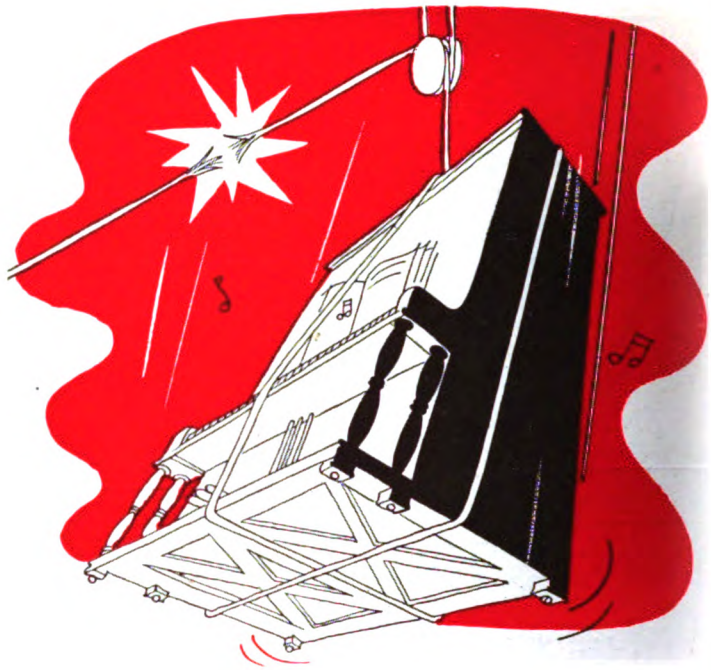
Get all the facts of this Ideal Power Unit. Call at your nearest Westinghouse office or write for B-3646–"IGNITRON UNIT SUB-STATION"–Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

Westinghouse *Electronics at Work*

J-10299

you wouldn't

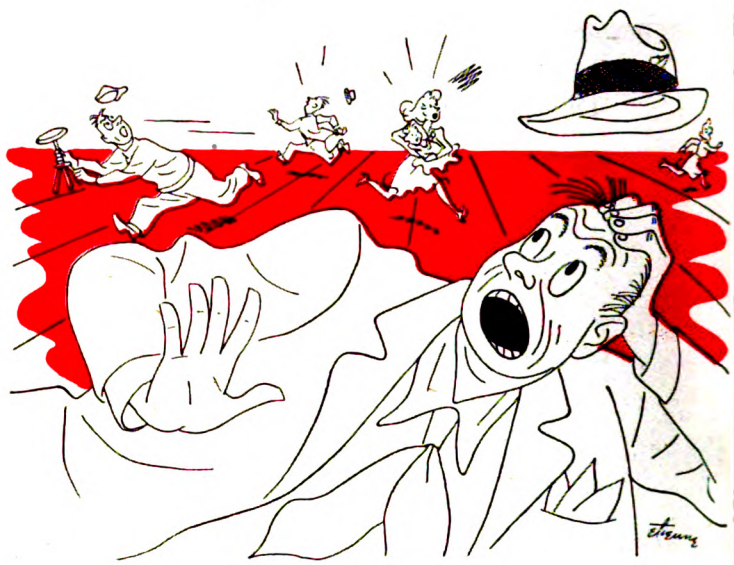
lift a 500 pound load with a 100 pound capacity rope



It is just as foolish to put carbide cutting tools on an out-moded lathe. Carbide tools have increased horsepower requirements as much as 300 per cent.

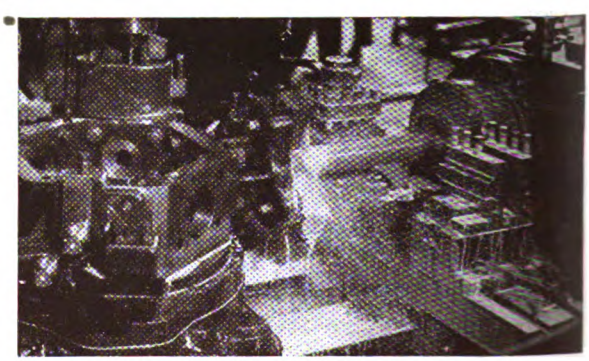
Modern Jones & Lamson Lathes are designed specifically to carry this extra load, and more. They have the power, they have the rigidity, they are easy to operate.

Now is the time to check your equipment. Plan now to scrap obsolete machines and replace them with good War Surplus machines or new machines. Our engineers will be glad to assist you.



What HORSEPOWER Are You Using?

This cut, on 2-inch bar stock, requires 300 per cent more horsepower with a carbide tipped tool than with a high speed steel tool, and Carbide halves the cutting time.



Engineered to "Carry the Load" for Most Productive Operation With Carbide Cutting Tools

JONES & LAMSON
MACHINE COMPANY
Springfield, Vermont, U.S.A.

Turret Lathes

Manufacturer of: Universal Turret Lathes • Fay Automatic Lathes • Automatic Double-End Milling and Centering Machines • Automatic Thread Grinders • Optical Comparators • Automatic Opening Threading Dies and Chasers.

YOUR 1946 CALENDAR IS READY

...with **GIANT SIZE** dates

Each numeral 1¾" high—that's the feature of this beautiful new six-color POST 1946 Calendar—overall size 12"x20". Each date of the week is designed to be legible from any spot in the drafting room. The entire current month with ultimate and proximate months appear on each weekly page. The calendar is in full, brilliant color and includes a section devoted to significant drafting room data, covering charts on wire and sheet metal gages, screw threads, bolt heads, pipe and pipe fittings, gears, metric equivalent, and complete twelve-month calendar.

The Frederick Post Company
3650 AVONDALE AVE • CHICAGO 18, ILLINOIS
DETROIT • HOUSTON • **CHICAGO** • LOS ANGELES • MILWAUKEE

Request for FREE 1946 Calendar.

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ADDRESS_____

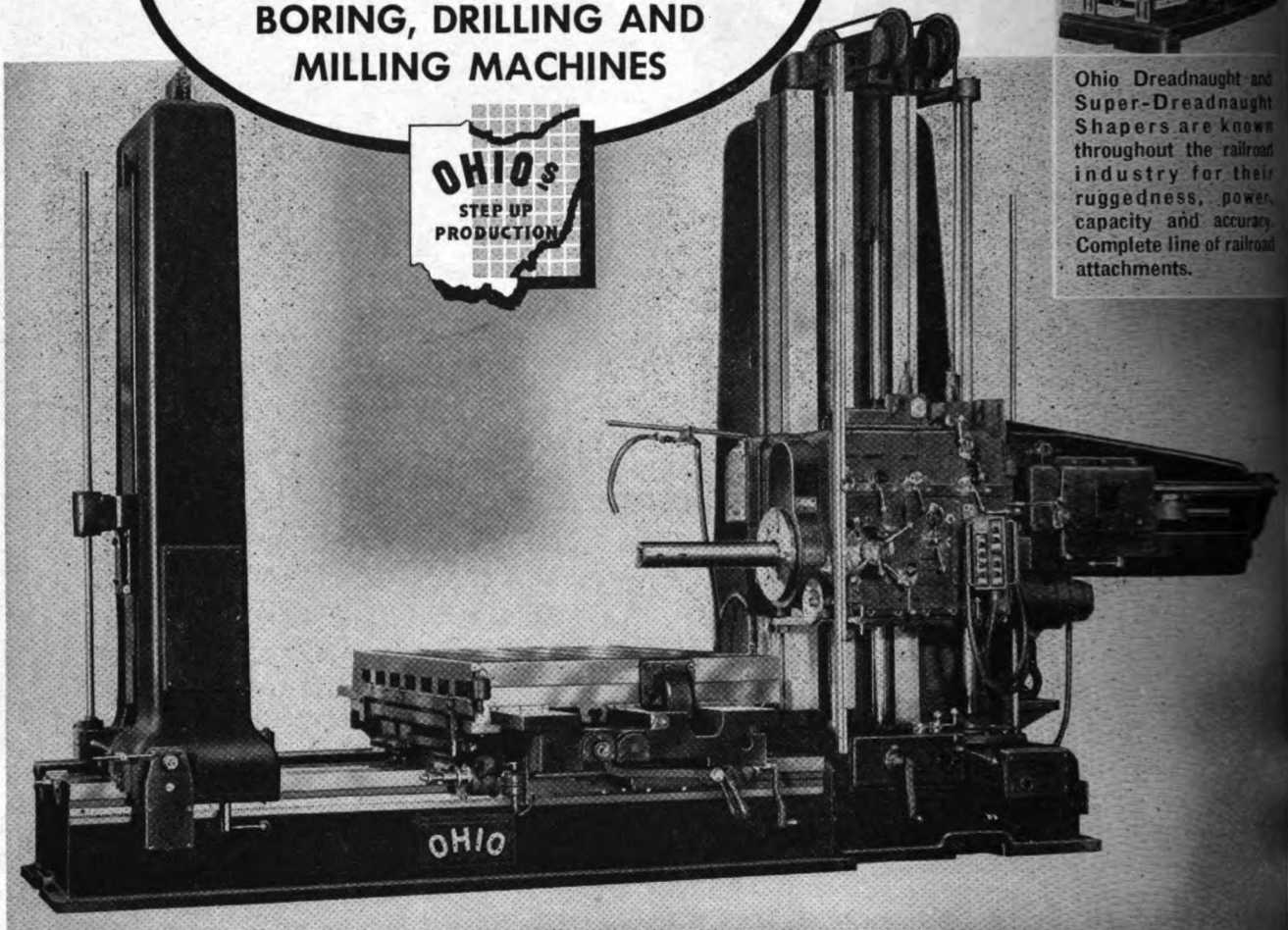
CITY & STATE_____

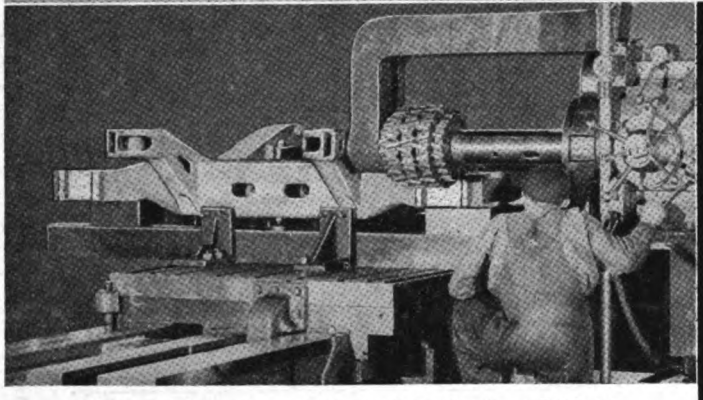
OHIO HORIZONTAL

BORING, DRILLING AND MILLING MACHINES

OHIO's STEP UP PRODUCTION

Ohio Dreadnaught and Super-Dreadnaught Shapers are known throughout the railroad industry for their ruggedness, power, capacity and accuracy. Complete line of railroad attachments.





Milling high tensile cast steel unit bolster for a Buckeye six-wheel locomotive tender truck on an OHIO horizontal.

Ohio Horizontal Boring, Drilling and Milling Machines, with their power, precision, convenience and safety, have helped make new records in the railroad field and elsewhere. They are available in 5″ and 6″ spindle sizes in both table and floor models. No reconversion delays; we are ready to serve you promptly. Write for Bulletin 1000.

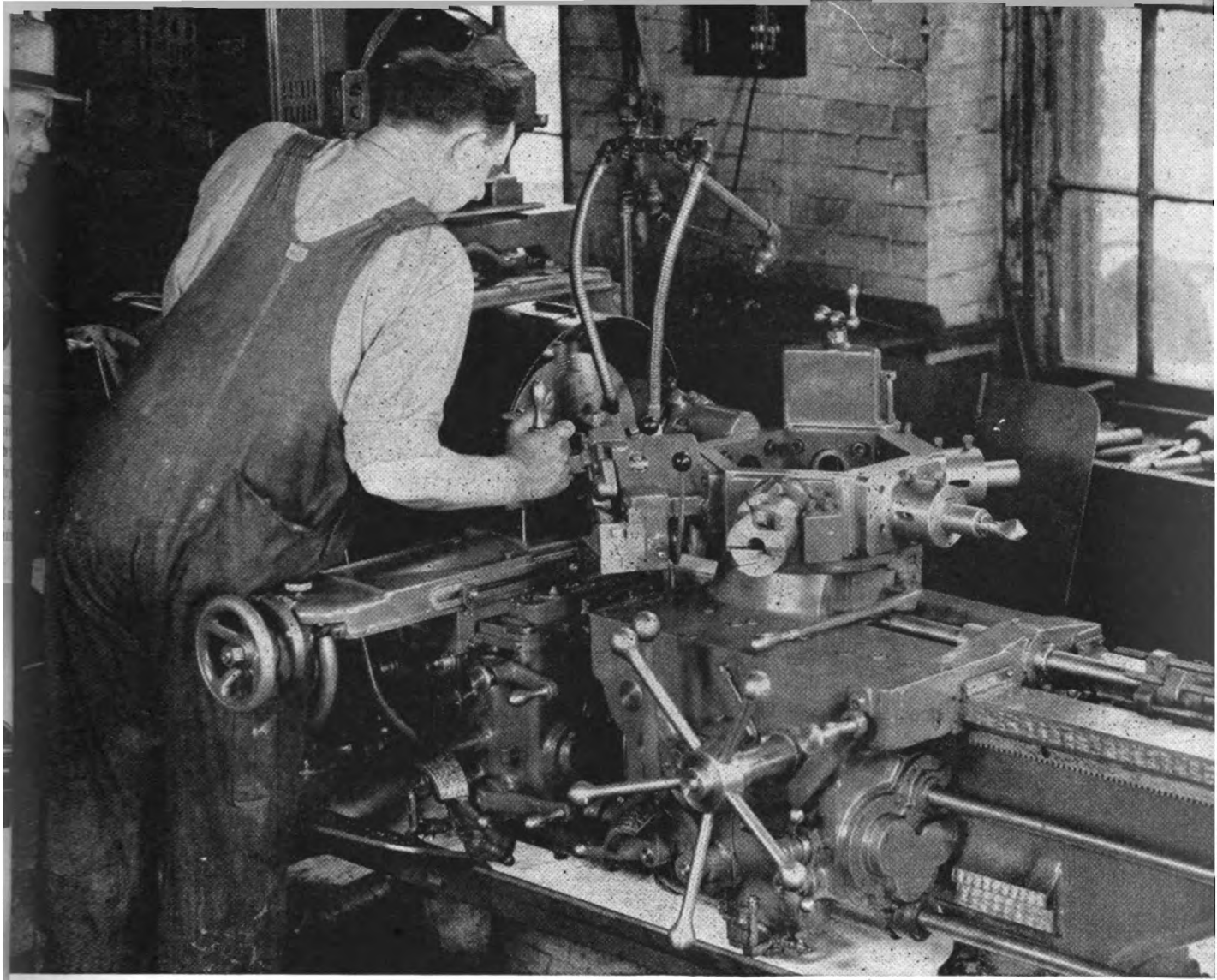
THE OHIO MACHINE TOOL COMPANY

Serving the Metal-Working Industry Since 1887

KENTON, OHIO

OHIO DREADNAUGHT

HORIZONTAL BORING, DRILLING AND MILLING MACHINES • SHAPERS • PLANERS



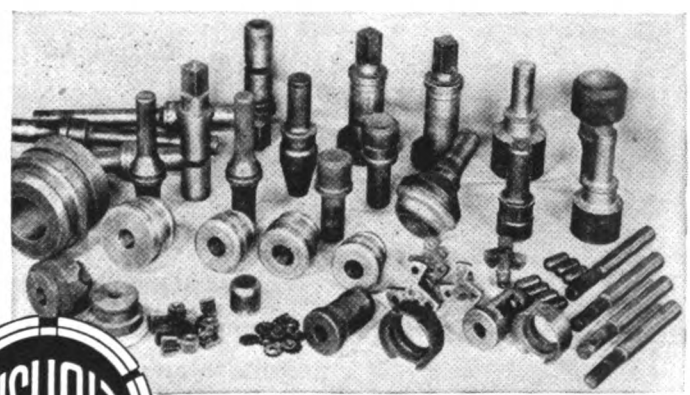
IN RAILROAD TOOL ROOMS, TOO

Gisholt Turret Lathes Pay Out

In meeting wartime emergencies, railroad shops all over the country have proved the value of Gisholt Turret Lathes—building stocks of standard replacement parts—saving time and money to keep the rolling stock rolling.

But here's another example—in the tool room of a locomotive boiler shop. Here Gisholt Turret Lathes are used to manufacture a variety of boilermaker tools and flue cleaner parts. Producing them even in such small quantities as 12 per lot, this Gisholt 1 L High-Production Turret Lathe proved itself both practical and profitable—doing more work than two other type lathes, and at lower cost.

Gisholt engineers, familiar with railroad shop work, will gladly discuss your particular problems with you.

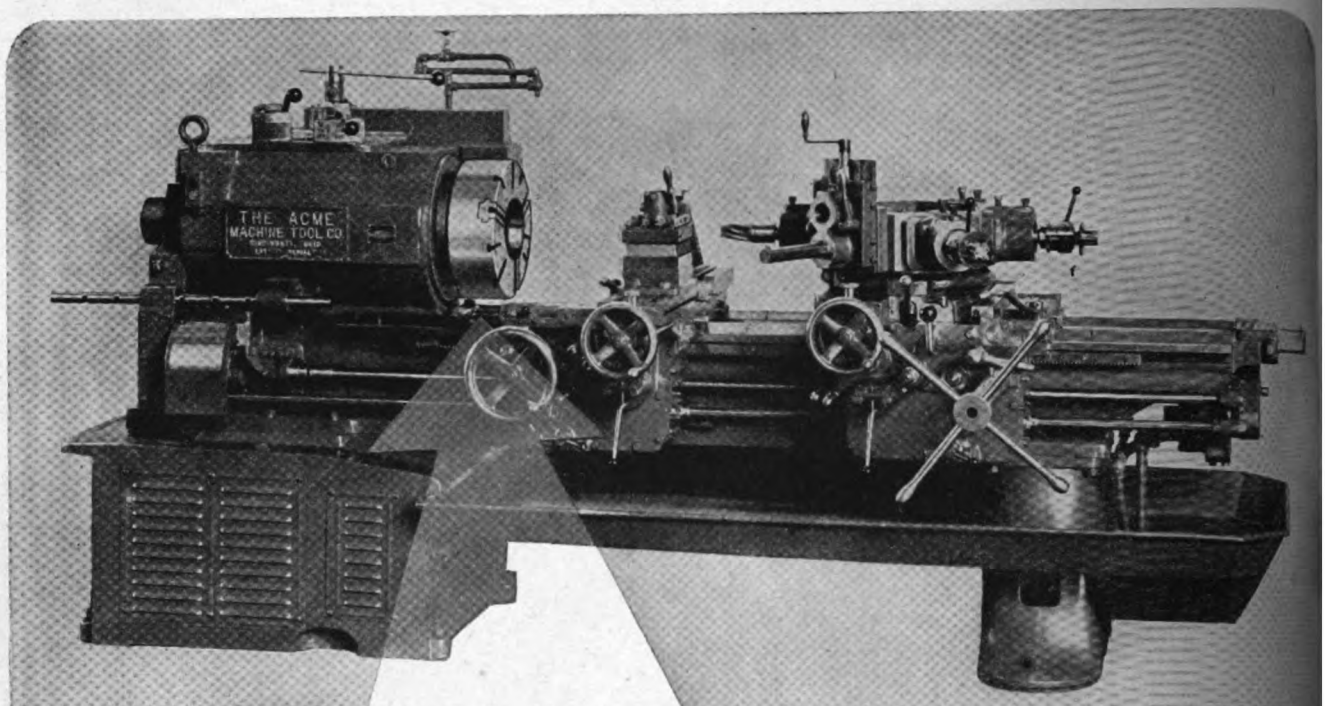


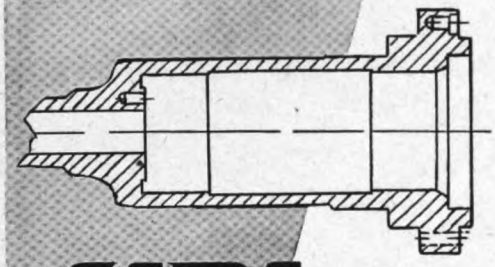
Boilermaker tools, flue cleaner parts and other miscellaneous railroad parts such as these are produced quickly, accurately and at low cost, thanks to Gisholt's easy tool set-up and simple operation. Complete information on request.

GISHOLT MACHINE COMPANY

1293 East Washington Avenue • Madison 3, Wisconsin

Look Ahead . . . Keep Ahead . . . With Gisholt Improvements in Metal Turning





ACME *gives greater spindle capacity*

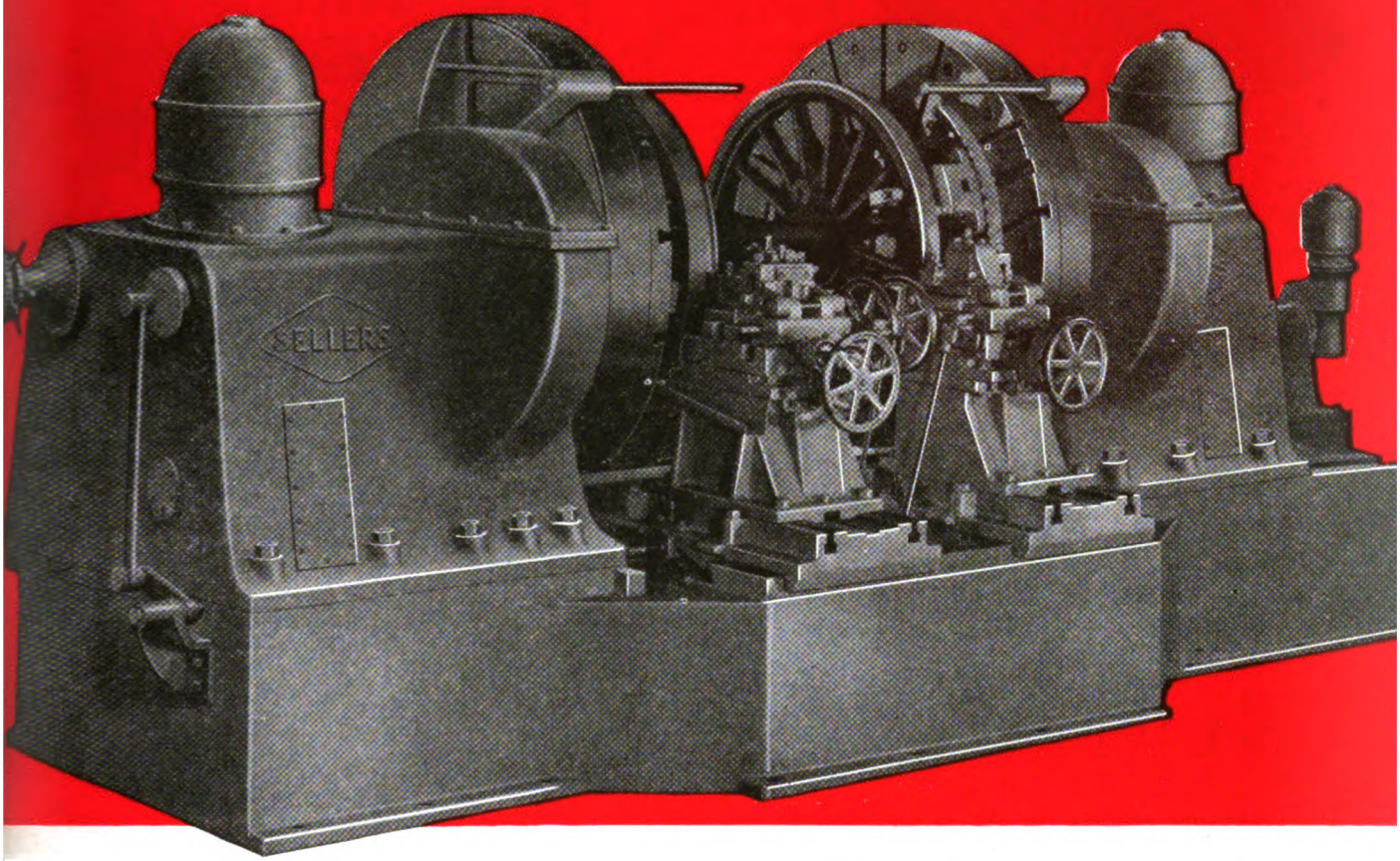
Now you can profit from increased versatility in this deep throat Acme Universal Turret Lathe. Designed especially to machine those forgings, tubings and similar large diameter pieces requiring a deeper throat and greater chuck capacity, this Acme Turret Lathe is a welcome addition to your plant.

This machine, likewise, includes a triple roller bearing spindle and brake, hardened steel vees, extended square turret cross slide and rear tool post, and rapid power traverse for longitudinal movement of the hexagon turret. All moving parts run in an oil bath.

We'll be pleased to furnish you specific information at your request.

The ACME MACHINE TOOL Co.
CINCINNATI 32, OHIO

Announcing . . .



THE SELLERS 90" DUAL DRIVE ENGINE DRIVING WHEEL LATHE

75 YEARS AGO (that's before your time) America's infant railroads and locomotive builders depended on Sellers lathes to true their engine driving wheels. These tools, though crude and slow, were the best available, and played no small part in the rapid growth of the world's greatest transportation system.

Today Sellers presents a Dual Motor Engine Driving Wheel Lathe of such accuracy and ease of operation that it has no counterpart in performance. Details of its design, capacity and operational features will gladly be sent you on request.

Wm. SELLERS & COMPANY

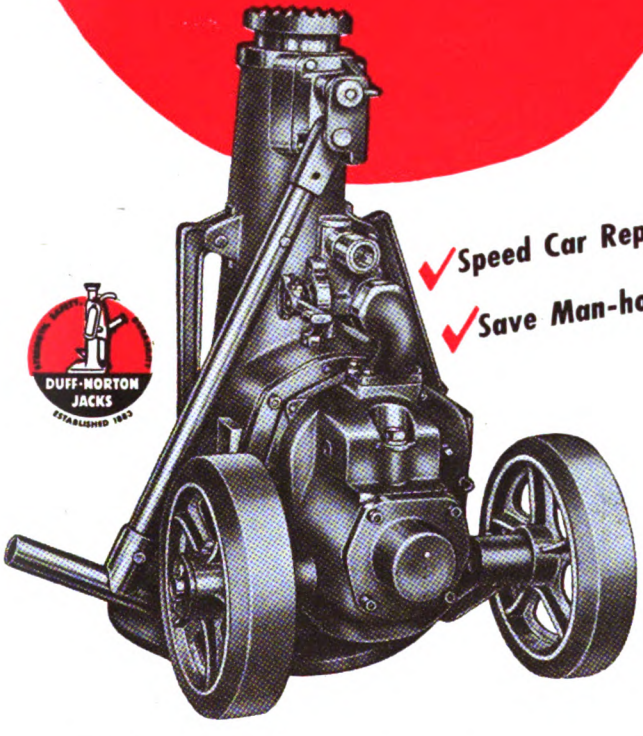
16th & HAMILTON STREETS • PHILADELPHIA

SELLERS PRECISION TOOLS SINCE 1848

Duff-Norton

Air Motor Operated

Power Jacks



✓Speed Car Repairs

✓Save Man-hours

Results of long shop service definitely prove the advantages of Duff-Norton Air Motor Operated Power Jacks, bearing out the claims for speeded-up repair work and man-hours saved.

The complete line of Duff-Norton Air Motor Jacks includes 5 types in capacities from 20 to 100 tons for every type of roundhouse and car shop work. Write for descriptive literature.

HERE'S WHAT THE EDITORS OF

Railway Mechanical Engineer

HAVE TO SAY...

Jack-Handle Days...

According to the best estimates of time-study men on one of our major railroad systems, two 50-ton air-operated jacks installed at an average freight car repair point today will have paid for themselves by savings in labor costs alone within 15 months.

That's Right! Paid for themselves within 15 months!

Even more important are the man-hours saved for use on other work and the increased speed of car release from repair points. Experience has shown that about 800 hours of mechanics' or helpers' time has been saved through such an installation during the course of a single year.

800 hours saved!

At an exceptionally busy shop point such an installation, made in 1937, was paid for within the first four months after the jacks were delivered.

Within the first 4 months

Various committees of the Car Department Officers' Association and other groups have urged consistently that more attention be paid in the expenditure of mechanical department funds to the needs of car repair points. Whether the men on the locomotive side have been more articulate in expressing their needs isn't clear but generally it appears that a new shaper for the backshop or a lathe for an enginehouse is more likely to be approved than two jacks for the car yard. Their relative cost is small, the rate of amortization on the investment high but at all too many points the jack-handle rather than the air-line lifts cars.

What is true of car jacks is true of many other items of equipment in use at car repair points. A thorough study on any system of the possibilities of employing modern tools and devices would enable car department officers to approach management intelligently with requests for appropriations. The accumulated labor cost and car-release delay time represented by jack-handle days should convince even a stubborn management in times much harder financially than the present.

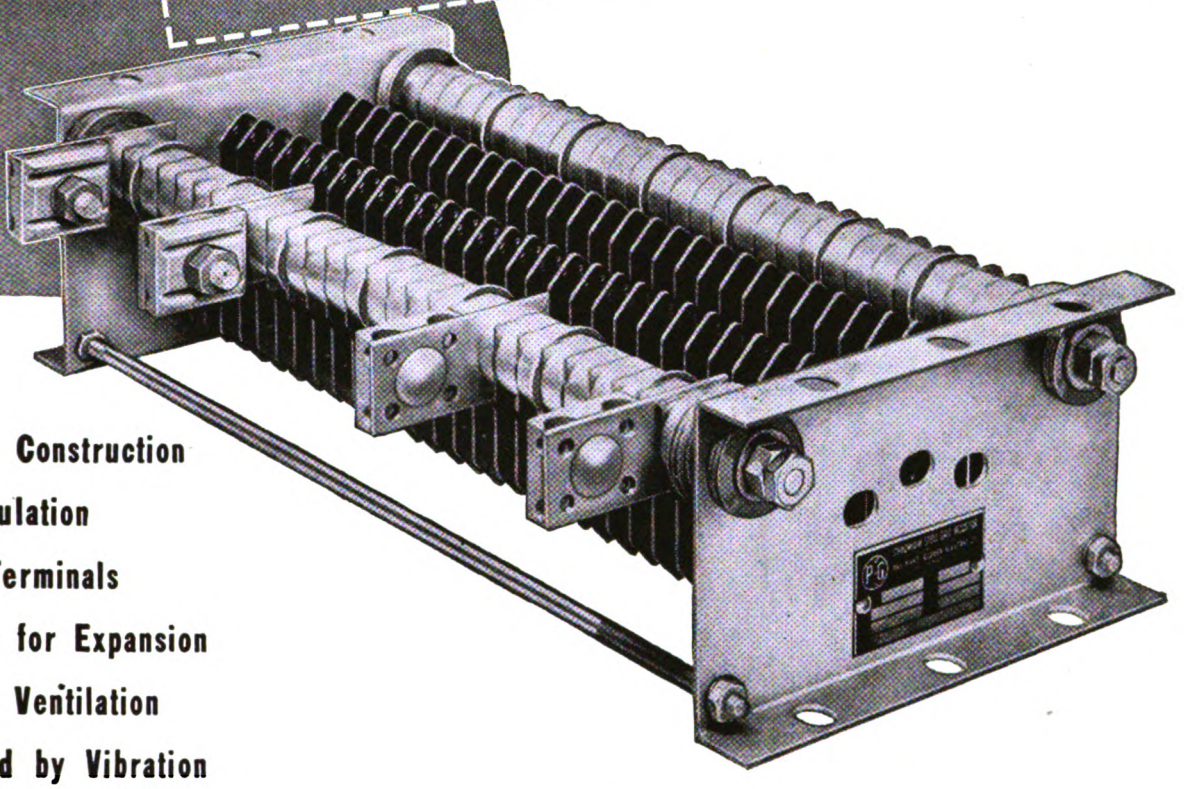
"An editorial appearing in a recent issue of Railway Mechanical Engineer."

THE DUFF-NORTON MANUFACTURING CO., Pittsburgh, Pennsylvania

CANADIAN PLANT: COATICOOK, QUE. • REPRESENTATIVES IN PRINCIPAL CITIES

POST-GLOVER

P-G... Nonbreakable STEEL GRID Resistors



All Steel Construction
Mica Insulation
Rugged Terminals
Provision for Expansion
Adequate Ventilation
Unaffected by Vibration
Moisture Resistant
Corrosion Protected

These Post-Glover Standard Resistor Units will increase production equipment availability thru reduction in motor maintenance and machine hours lost from electrical failures. P-G Steel Grid Resistors are rugged because they are built of steel and mica. Add to this, sound resistance values with ample capacities and failures due to resistor trouble cease to exist. Specify P-G for your next application, especially, if your operating conditions are severe.

BULLETIN No. 500 IS AVAILABLE FOR DETAILED RESISTOR DATA

P-G

The Nonbreakable Steel Grid Resistor

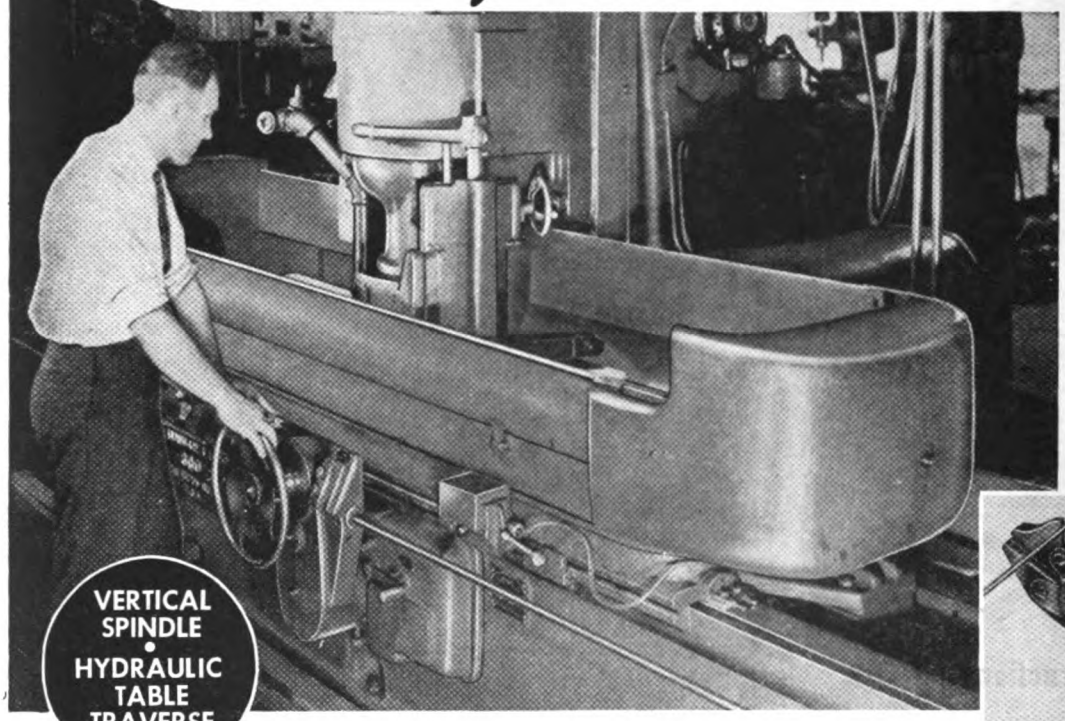
THE POST-GLOVER ELECTRIC COMPANY

• ESTABLISHED 1892 •

221 WEST THIRD STREET, CINCINNATI 2, OHIO

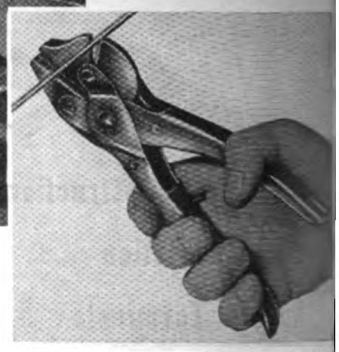
MEET TOOLROOM TOLERANCES

On High Production Runs



VERTICAL SPINDLE • HYDRAULIC TABLE TRAVERSE

The Wm. Schollhorn Co., New Haven, Conn., uses this Hanchett 300 to finish-grind jaw members and other parts for Bernard Pliers. Also handles work up to 12" wide, 30" long and 10" high.



Bernard Pliers are produced in volume, sell at low cost. Grinding parts on the 300 helps keep production costs at a minimum.

with the HANCHETT "300" Surface Grinder!...

Here's a typical problem solved with a Hanchett 300 Surface Grinder:

The Wm. Schollhorn Co. manufactures Bernard Parallel-Action Pliers — mass-produced hand tools that have many replaceable and interchangeable parts. For this reason stock must be removed within extremely close tolerances — yet the finishing cost per unit kept very low.

That's why the Hanchett 300 got the job. Its long, rectangular magnetic chuck firmly grips a large number of small parts — no fixtures needed. Since the 300 is semi-automatic, operator merely loads chuck, starts machine and unloads finished pieces — a fast, simple operation. And the 300 works easily to tolerances of .0002 — assured accuracy on every piece!

USE THE 300 FOR GRINDING

Dies . . . Knives . . . File Blanks Parts for Locomotives, Automobiles, Aircraft and Home Appliances.

The Hanchett 300 is built in several sizes, for varying requirements. And remember — Hanchett manufactures *all* types of Surface Grinders. If your problem is Grinding, consult Hanchett. You can be sure of unbiased information at no obligation. Write today for Bulletin

Write Today for Bulletin 161-8RL

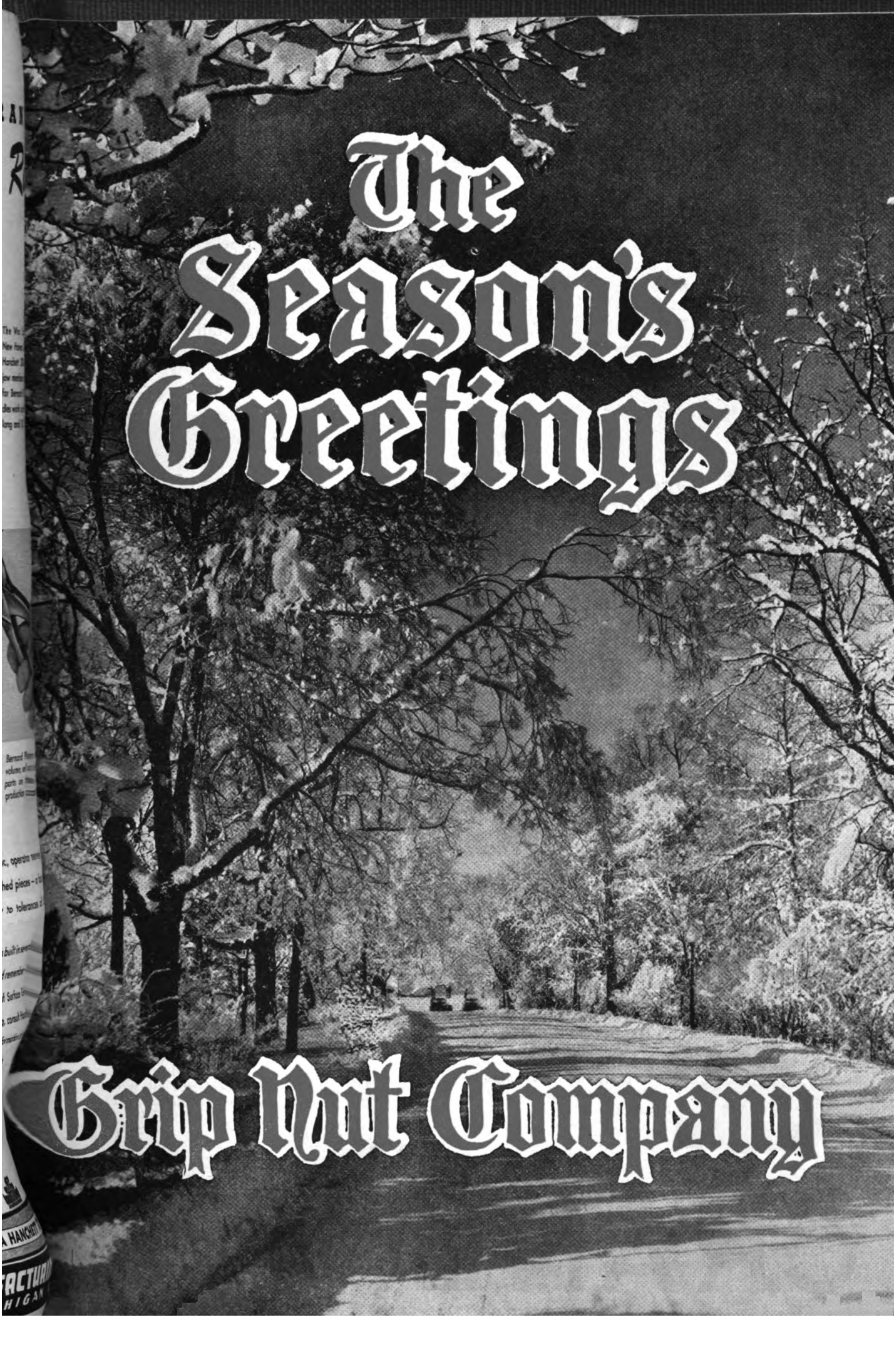
HANCHETT HERMETI-COIL MAGNETIC CHUCKS

HANCHETT GRINDERS BIG RAPIDS MICHIGAN

IF IT'S A FLAT SURFACE—THERE'S A HANCHETT TO GRIND IT

HANCHETT MANUFACTURING CO.

BIG RAPIDS, MICHIGAN U.S.A.


The
Season's
Greetings
Grip Nut Company

Railroads Can Count on CRANE for this Vital Equipmen

ONE SOURCE OF SUPPLY
ONE RESPONSIBILITY
ONE STANDARD OF QUALITY

In meeting the needs of modernization and building programs . . . with complete assurance of ample selections and adequate supplies of these three classes of equipment . . . your logical partner is Crane. Depending on Crane not only simplifies buying procedures; you buy with complete confidence because of Crane Co.'s long experience in manufacturing to railroad standards and the ability to help apply this equipment most efficiently.

1. Modern Plumbing fixtures for passenger cars

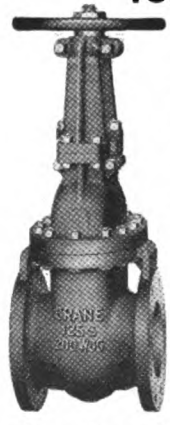
Complete selections of smartly styled, compact, durably built fixtures in practical designs for all passenger accommodations. In every one installed in your cars, the sparkling, easy-to-clean beauty of Crane vitreous china, the dependability of working parts, plus the prestige of Crane in home plumbing, will give evidence of careful attention to travelers' comfort and convenience.

CAR PIPING EQUIPMENT—Crane Railroad Plumbing includes valves, fittings, and pipe for all utility services.

2. A.A.R. Valves & Fittings

Valves and fittings marked Crane-A.A.R. give you positive assurance of rigid adherence to specifications and of like dependability in every item. Choose from a wide range of brass globe and angle valves, and malleable iron fittings, unions, and union fittings, also A.A.R. forged steel unions.

3. Piping Materials for all railroad needs . .



For a truly complete piping material service—for installations in shops, power houses, service buildings, stations, or on rolling stock—come to Crane. Choose for every need from the world's largest selections of quality valves, fittings, pipe, piping specialties and fabricated piping—in brass, iron, and steel—for all working pressures and temperatures.

CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

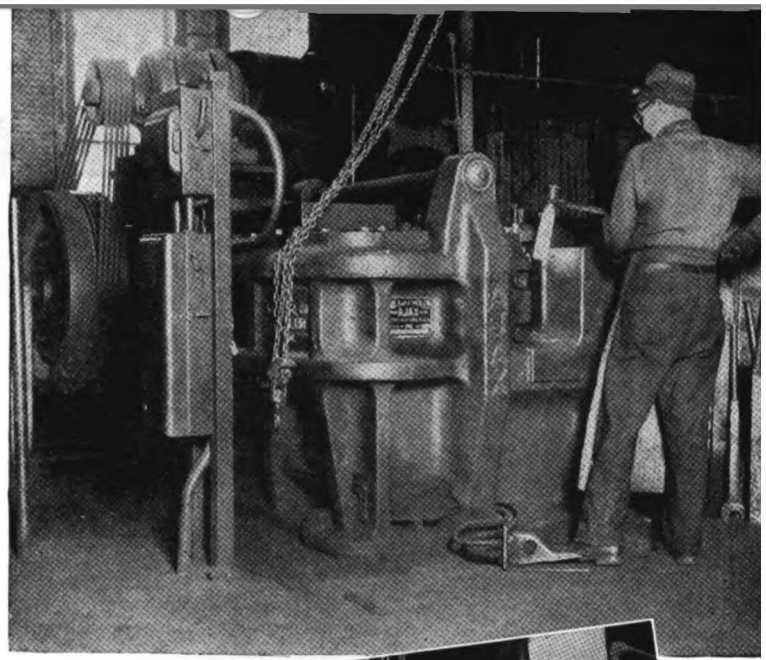
CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

RAILROAD SHOPS USE

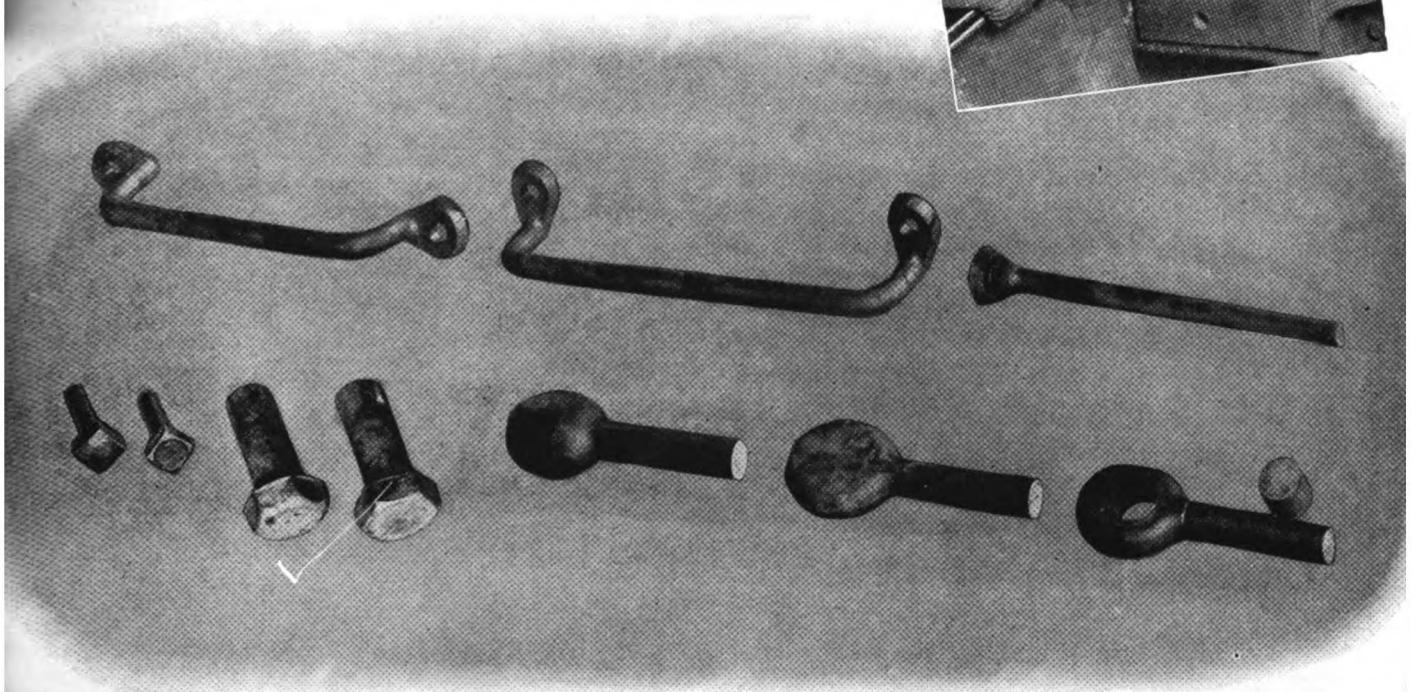
AJAX FORGING MACHINES

FOR HIGH SPEED, LOW COST PRODUCTION OF A WIDE RANGE OF FORGINGS



RAILROAD shops continuously require a large variety of forgings such as Brake Pins, Grab Irons, Brake Hangers, Square Head and Hex Head Bolts, Miscellaneous Pins, Rivets, etc. Since forgings are such an important part of their daily production operations it is most essential that their forging machines provide the widest range and greatest dependability, coupled with high production at low cost. AJAX FORGING MACHINES, built on the basis of mechanical soundness, with their exclusive, patented mechanical features, meet these exacting requirements and are being used extensively in Railroad Shops throughout the world.

Write for Bulletin 65-B



THE AJAX MANUFACTURING COMPANY

EUCLID BRANCH P. O. CLEVELAND 17, OHIO

110 S. DEARBORN ST. • CHICAGO 3, ILLINOIS

"Built to take it!"

GARLOCK 7021 Compressed Asbestos Sheet Packing is available in sizes 40" x 40" and larger. Thicknesses 1/64" to ¼".

GARLOCK 7022 Gaskets—cut from this sheet—are available in all sizes and shapes.

Garlock 7021 Sheet Packing won't have to stand up against the impact of a rushing ram, of course, but if it did we think it could take it. For this compressed asbestos sheet is plenty tough. GARLOCK 7021 gives exceptional service on pipe lines and other equipment handling gasoline, oil, gas or steam at high temperatures and extreme pressures. Avoid gasket failures and expensive shutdowns by standardizing on GARLOCK 7021.

THE GARLOCK PACKING CO.
PALMYRA, NEW YORK

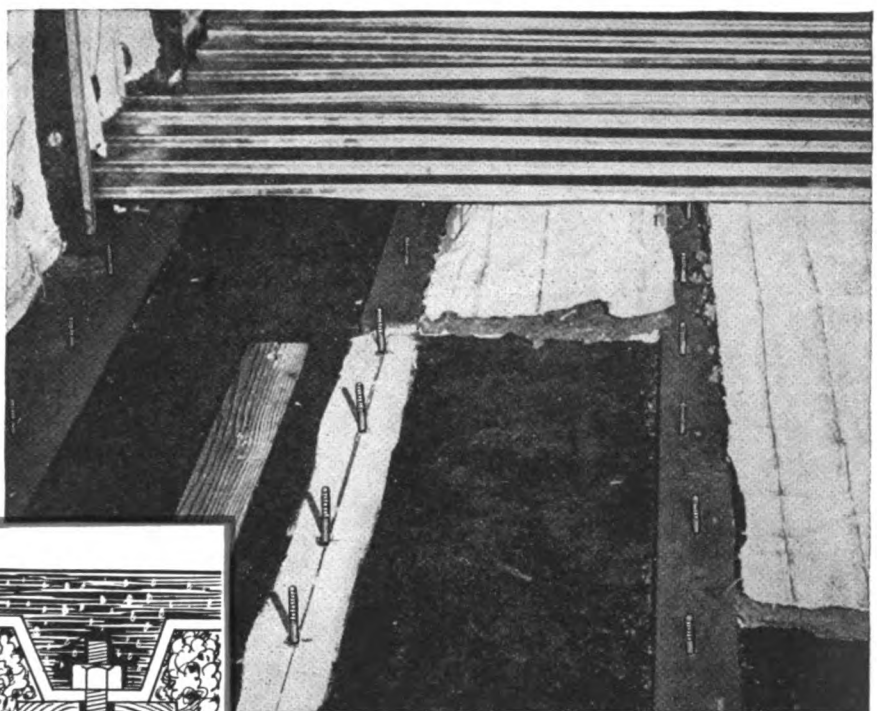
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK

7021

COMPRESSED ASBESTOS SHEET PACKING

How to speed up CAR RE-FLOORING with NELSON STUD WELDING



Photograph courtesy Southern Pacific Company

FORMERLY, the passenger car re-flooring job shown at right required drilling through car sills and floor beams to take through-bolts securing the furring strips and interlocked steel sub-flooring. In order to insert and tighten the bolts, it was necessary to remove much of the equipment underneath the car, all of which had to be reinstalled.

With the Nelson Stud Welder on the job, the necessary studs were welded on top the car sills and floor beam as shown in the photo (welding time, ½ second per stud). The drilled furring strips and sub-floor sections were slipped over the studs, nuts run down, and the composition flooring troweled in and finished. No under-car equipment was removed; in fact, no man was required beneath the car at any time. The result was a securely-anchored floor, completed days ahead of usual time.

Flooring installation is just *one* of the jobs that the Nelson Stud Welder can do *better* at substantial savings in time and money. Studs from ⅛″ to ¾″ in diameter, and up to 8″ long, can be welded in any position in a half second; the completely-automatic Nelson Stud Welder is easily portable, works from any standard welding generator, and is compact for easy handling in "tight" places. It's a versatile tool that will more than pay its way in *any* shop, on repair, maintenance or new construction work. Full information available on request, or a demonstration at your convenience will gladly be made by our nearest Field Engineer. Write or wire:

NELSON

SALES CORPORATION

LORAIN, OHIO

Representatives and Distributors for

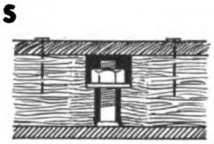
Nelson Specialty Welding Equipment Corp.
San Leandro, California

Nelson Stud Welding Corp.
Lorain, Ohio

OTHER NELSON FLOORING METHODS

SLOTTED NUT AND STUD

WATERTIGHT SCREW AND FEMALE STUD



STUD SECURING FURRING STRIP

OTHER NELSON FLUX-FILLED STUDS

Cars washed clean . . . at the rate of one car per minute

WHITING CAR WASHERS MEAN FAST, THOROUGH WASHING JOBS

Whiting Car Washers handle coaches, tenders, and Diesel-electric locomotives at the rate of 90 feet per minute—and cars go back into service *clean.* All models safeguard car finish by using either water sprays alone or cleaning solution, followed by a carefully timed water rinse. Self-aligning brushes automatically compensate for car tilt and assure thorough washing. Write for information.

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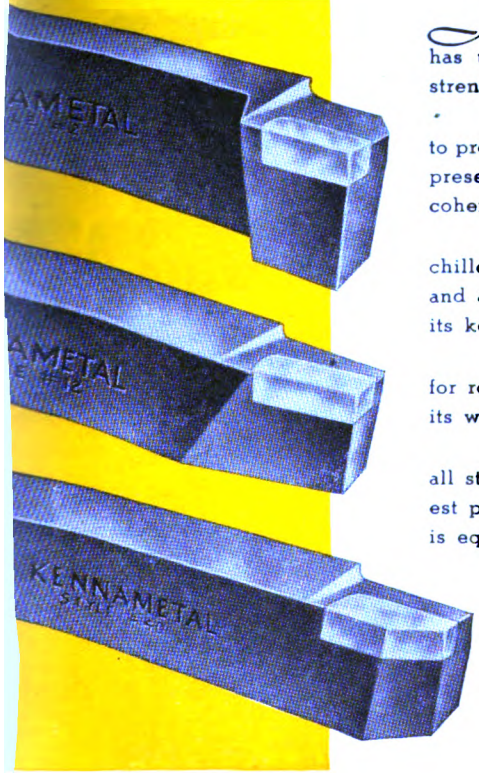
Offices in Chicago, Cincinnati, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, and Washington, D. C. Agents in other principal cities. Canadian Subsidiary: Whiting Corporation (Canada) Ltd., Toronto, Ontario.

KENNAMETAL K6...

the 2 in 1 CAST IRON CUTTING GRADE

HARDNESS *to resist ABRASION...*

STRENGTH *to resist SHOCK...*



In providing a carbide for cast iron jobs involving rough or interrupted cuts it has usually been considered necessary to sacrifice some hardness for the sake of strength, with consequent shortening of tool life.

This is no longer necessary. Metallurgists of Kennametal Inc. have found a way to produce a 2 in 1 composition. It is hard *and* strong. These characteristics are both present to a high degree in Kennametal K6 grade, because of its uniform, strongly-coherent structure.

It has ample strength to withstand the shock of machining rough, sandy, or chilled castings, even though they are out of round, or have surface interruptions—and at the same time it has sufficient hardness to effectively resist abrasion, and hold its keen edge for a remarkably long time.

This new and improved tungsten carbide can be used with entire satisfaction for roughing, finishing, and precision boring. Scores of cases on record demonstrate its widespread effectiveness.

K6 blanks, and complete single point tools, are now available from stock in all standard styles and sizes. Use them on cast iron machining jobs to assure highest production with lowest tool cost. Remember also, that this grade of Kennametal is equally effective on milling—which is essentially interrupted cutting.

KENNAMETAL

TRADE MARK REG. U. S. PAT. OFF.

SUPERIOR CEMENTED CARBIDES

KENNAMETAL *Inc.*, LATROBE, PA.

FOR ALL THESE SERVICES...

Cut away view of a Walseal Tee showing ring of silver brazing alloy and completed Silbraz* joint.

Air brake piping on cars and Diesel locomotives

Water cooling lines on Diesels

Hot and cold water systems on cars

Air conditioning systems on cars

Lubricating oil circulating systems on Diesel locomotives

Steam heating systems using copper convectors, on cars and Diesel locomotives

specify **SILBRAZ ★ JOINTS**

MADE WITH WALSEAL* PRODUCTS

Yes, on tough jobs like these, where brass or copper pipe or copper tubing is used, Walseal bronze valves, fittings, and flanges do a two-fold job.

1. They make leakproof, trouble-free connections that are permanent . . . vibration-proof, corrosion-resistant — connections that will not creep or pull apart; that literally join with the pipe to form a "one-piece pipe line."

2. They eliminate the need for maintenance and costly repairs — especially important where lowered operating costs are imperative.

For these reasons more and more piping installations are being made with the modern Silbraz joints, using Walseal products. For complete details on Walseal products, write for a free copy of Walworth Circular 84.

No. 95WS — 150-Pound Bronze Globe Valve with Renewable Disc, Lock-on Disc Holder, and Walseal Ends.

No. 225PWS — 350-Pound Bronze Globe Valve with "500 Brinell" Plug Type Seat and Disc, and Walseal Ends.

Walworth also manufactures a complete line of bronze, iron, and steel valves and fittings, including a complete line of bronze A.A.R. and Monel Globe and Angle Valves. A detailed description of the entire line is included in Catalog 42. Write for your free copy today.

*Patented — Reg. U. S. Pat. Off.

Make it a "one-piece pipe line" with WALSEAL

WALWORTH

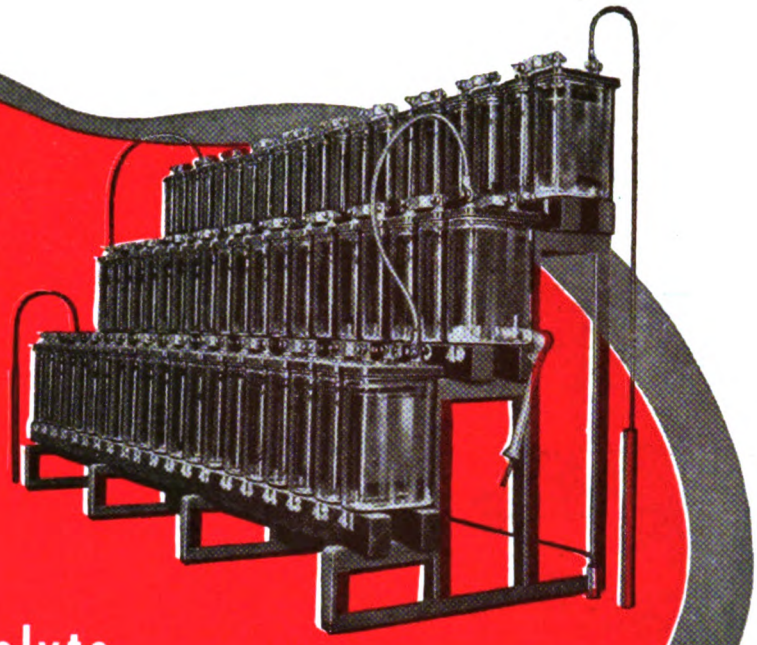
valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

PROBLEM:

To find insulated cable for battery-charging leads—immune to attack by electrolyte



SOLVED WITH FLAMENOL CABLE

An Ohio steel mill required insulated cable for its battery-charging equipment, which consisted of a 250-kw generator and a 27-panel switchboard. Cable was needed for leads from panels to batteries. As the leads ran underground, the cable insulation had to withstand moisture as well as electrolyte fumes and accidental contact with the electrolyte itself. Four years ago, at G.E.'s suggestion, Flamenol* Style FL insulated cable was selected for the job. The mill reports that the original installation is still giving trouble-free service.

RESISTS CHEMICALS— Flamenol Style FL cable is highly resistant to oils, water, mild acids, and alkalies—and weather. It is tough and stable, is flexible at low temperatures, and has high dielectric strength. Flamenol does not support combustion—therefore, prevents outages due to fires. Requiring no protective braid, it reduces the volume of wiring and eliminates terminating problems due to fraying. Its insulation strips easily and leaves the conductor surface untarnished.

A G-E "FIRST"— Only G.E. makes Flamenol cable. Flamenol is the original cable insulated with plasticized polyvinyl chloride. G.E. introduced it in 1935—not as a substitute for rubber-insulated cable but as a new type possessing desirable properties not obtainable in rubber. To find out how Flamenol can help solve *your* problem—save you time, trouble, and expense—ask our local office, or write Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

*Trade-mark reg. U.S. Pat. Off.

GENERAL ELECTRIC

502-54-1200

Keep on buying BONDS—and keep all you buy

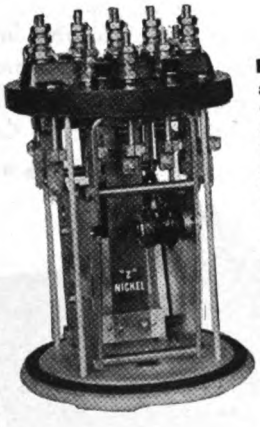
How 6 ENEMIES of METALS are being defeated in typical uses by Inco Nickel Alloys

ABRASIVE SCALE particles hammer at the seats of blow-off valves . . . corrosive and erosive hot waters add their destructive force. Yet the *first* Monel trim on a T.Z. valve used by the New Haven was still in service after 12 years! A recent count showed 272 of 331 New Haven locomotives equipped with Monel-trimmed T.Z. valves. A New Haven executive writes "...The Monel seats have given very satisfactory service . . . very few have been renewed . . ." ***INCO Nickel alloys defeat abrasion.***

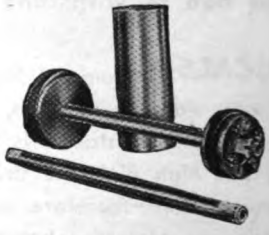
EROSIVE STEAM, direct from the locomotive boiler, blasts with full force at the inner cylinders of steam separators, often causing failure in as little as 3 months. Over 4 years ago, the Dri-Steam Products Co. fabricated a new-type separator of Monel. Since then, with more than 300 in service, not one Monel separator has failed! In addition to long life, the Monel separator costs 30% less . . . weighs only half as much as separators made of the metal formerly used. ***INCO Nickel alloys defeat erosion.***

CORROSIVE WATERS cannot harm the fine (.006") wires that form the Knit Metal Mesh feedwater filters used by the Vermont Central R. R. The 14" x 20" pads provide 15,000 square inches of filtering surface with a million meshes to snare dirt, scale and oil from the feedwater. They are easily cleaned with steam or any ordinary solvent . . . resist breakage and corrosion because they are knit of strong, tough, corrosion-resistant MONEL. ***INCO Nickel alloys defeat corrosion.***

TEMPERATURES TO 750° F.... more than 200° F. beyond the limit usually considered reasonable for bronze valves . . . and pressures to 400 psi. had to be handled by valves in Burlington Engine No. 3012, built in 1935. Walworth built valves with all-Monel bodies were installed. Now, after more than 1,150,000 miles of service, the majority of the original Monel valves are still at work. Burlington states: "Monel valves are one of the few foolproof parts of a locomotive." ***INCO Nickel alloys defeat high temperatures.***



FATIGUE . . . 100,000,000 flexings a year must be withstood by the spring pendulum used in the Code Transmitter built by the Union Switch and Signal Company. The transmitter, operating directly through track rails to wayside signal, engine cab signal, or both, shows traffic conditions on the trackage under its control. The spring which vibrates as much as 100,000,000 times a year is made of fatigue-resistant "Z" Nickel. In years of service, not one "Z" Nickel transmitter spring has worn out. ***INCO Nickel alloys defeat fatigue.***



HEAVY STRESSES, corrosive gases and abrasive grit gang up on locomotive boiler feed pumps. Sending 110 to 200 gallons of water into the boiler at a rate of 74 to 80 strokes per minute, the pump must withstand heavy stresses. The rods are exposed to grit, sleet and corrosive gases. Linings must retain a smooth highly polished surface. Since 1922, Worthington Pump & Machinery Co. has been making vital parts of these pumps from Monel. ***INCO Nickel alloys defeat heavy stresses.***

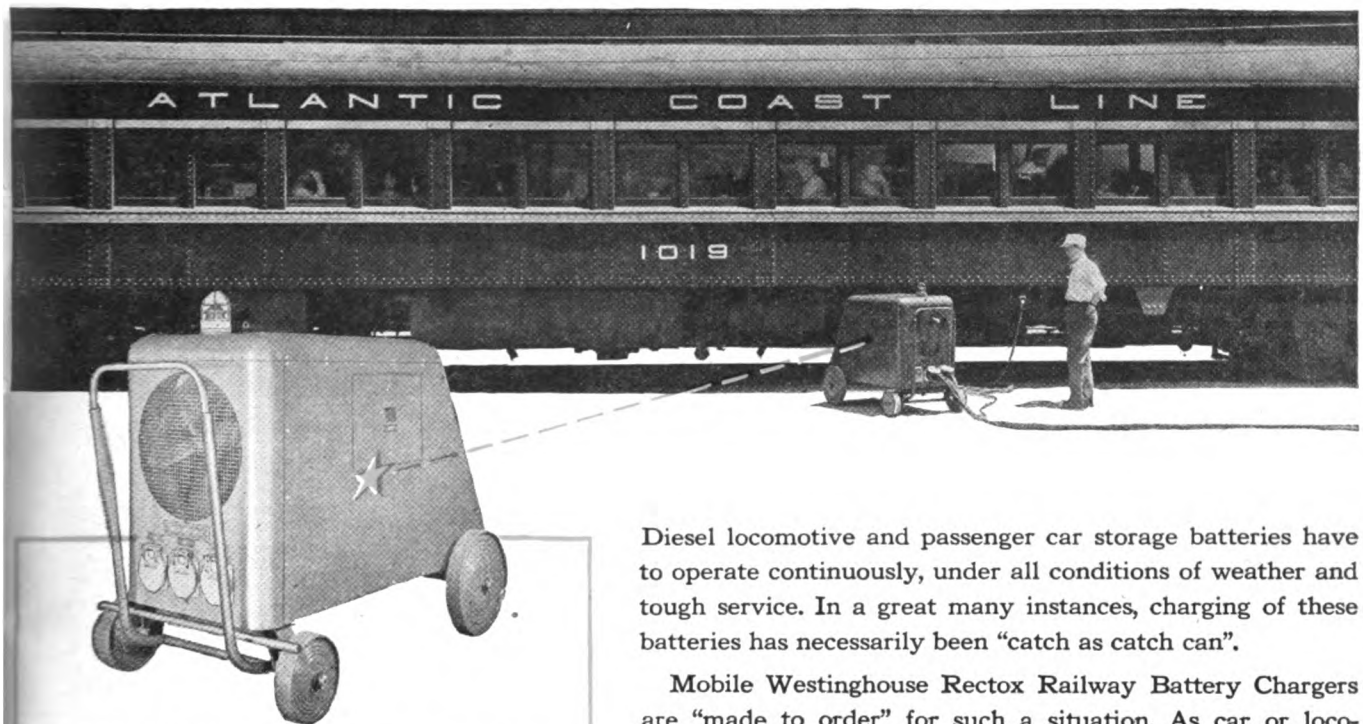
THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

NICKEL INCO ALLOYS

MONEL • "K" MONEL • "S" MONEL • "R" MONEL • "KR" MONEL • INCONEL • "Z" NICKEL • NICKEL • *Sheet . . Strip . . Rod . . Tubing . . Wire . . Castings . . Welding Rods (Gas & Electric)*

RECTOX BATTERY CHARGER

FOR A FULL-CHARGE *IN THE YARD* OR A BOOSTER-CHARGE ON A SHORT *"LAYOVER"*



Diesel locomotive and passenger car storage batteries have to operate continuously, under all conditions of weather and tough service. In a great many instances, charging of these batteries has necessarily been "catch as catch can".

Mobile Westinghouse Rectox Railway Battery Chargers are "made to order" for such a situation. As car or locomotive rolls to a stop, the Rectox charger is rolled up—is plugged into the 230-volt, 3-phase, 60-cycle, a-c outlet, also plugged into the battery . . . the selector and tap switches set, and the battery is immediately "on charge".

Car or locomotive *standing time* becomes Rectox *charging time*—from short boost to full seven to eight-hour charge.

The nonautomatic type is for manual control, boost charging.

The automatic type has a temperature compensated voltage relay for two-rate charging of lead-acid batteries. Nickel-Alkaline batteries are charged by the modified constant current system. An adjustable time switch automatically terminates the charge.

Another invaluable Westinghouse contribution to modern railroading, Rectox is timesaving, battery-saving and moneysaving. For complete information call your nearest Westinghouse office or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-21354

RECTOX Offers All These Advantages

ADAPTABLE—Automatic or nonautomatic types available; for either Diesel locomotives or passenger car batteries.

ROLLS FROM CAR TO CAR—Its narrow width permits use between adjoining tracks. Low center of gravity minimizes danger of tipping. Has parking brake.

DEPENDABLE AND "TROUBLE-FREE"—over an unlimited life, with low maintenance.

ECONOMICAL—High charging efficiency, particularly on 50% to 75% load, lowers power costs.

SAFE—Thermal-overload protection; battery circuit fused.

A RECTOX COPPER OXIDE DISC

The Rectox plate assembly is composed of a series of large copper oxide plates, 4⅜" x 12" assembled on an insulated bolt. Rectox Rectifiers, installed more than 16 years ago, continue to give dependable operation.

Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Rectox RAILWAY BATTERY CHARGERS

Build up worn Crown Brass this service-proved way

CROWN BRASS and other bearing surfaces that have become worn can be reconditioned quickly and economically with Airco No. 19 bronze. This electrode was developed especially for building up worn bearing metal by welding, and it is successfully employed by a number of railroads.

Airco No. 19 bronze has a high lead and tin content, with virtually the same analysis as poured brass bearing metal. It is applied either by carbon arc or metallic arc welding.

Quantities of worn crowns may be built up quickly by use of a positioner similar to that shown above. The bronze deposit is applied to the back and face of the crown for a distance of four or five inches from the toe edges.

Crown and back end main rod brasses after having been built up with Airco No. 19 bronze.

Service-worn welded crowns can be rebuilt many times by welding providing the brass remains in good condition.

Driving box laterals, shoes, wedges, and other locomotive wearing parts can be rebuilt and maintained economically by this method. For further information, fill in the coupon, and mail today.

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Air Reduction

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New York 17, N.Y.

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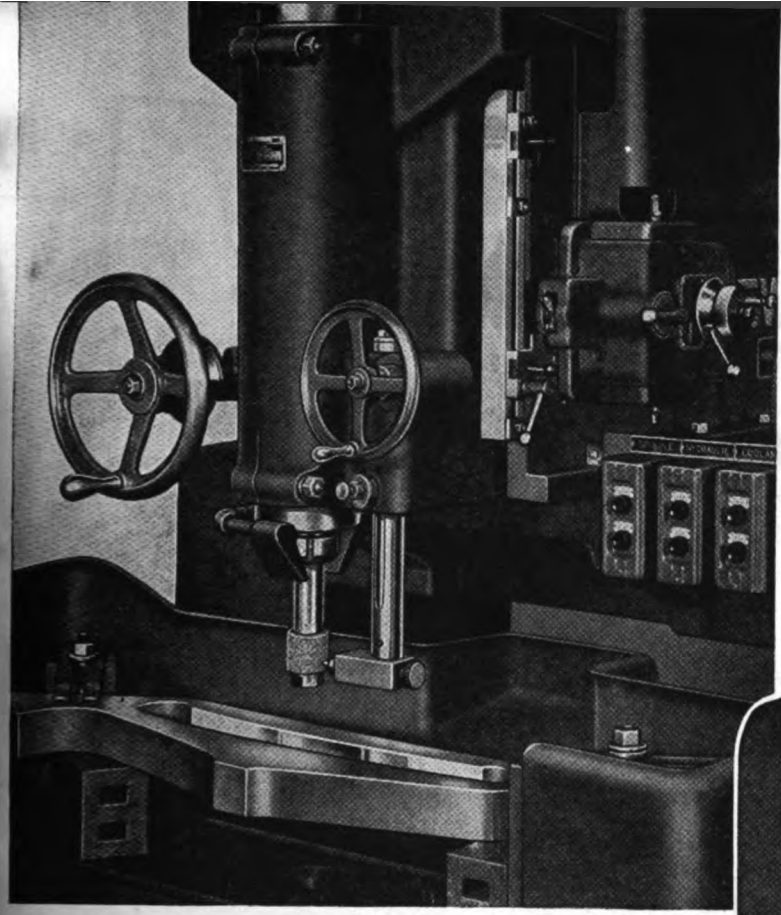
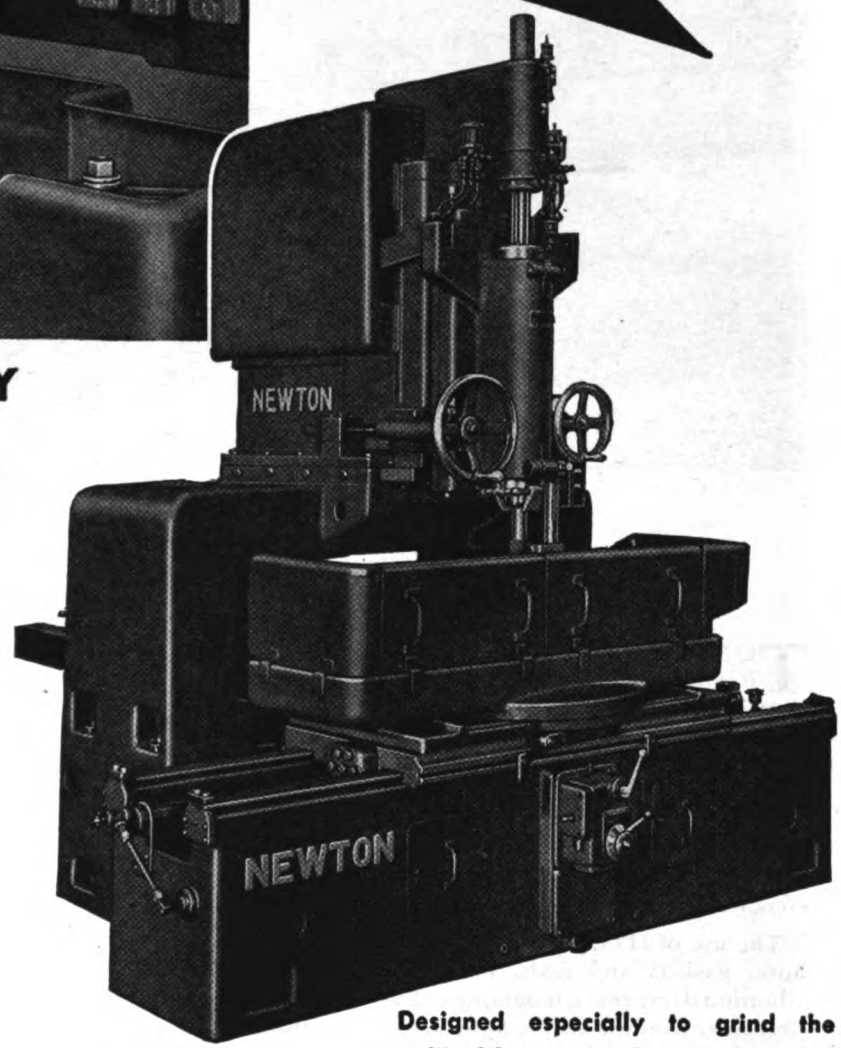


A NEW CONSOLIDATED RAILROAD SHOP TOOL

NEWTON HEAVY DUTY RADIUS LINK GRINDING MACHINE

Bulletin No. 850 covering this new Newton Radius Link Grinding Machine is now ready. Send for your copy today.



Among Railroad Tools built by Consolidated are . . .

CAR WHEEL BORERS
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JOURNAL TRUING LATHES
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ROD MILLING MACHINES
CYLINDER BORING MACHINES
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CRANK PLANERS
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AND OTHERS

Designed especially to grind the radii of locomotive links and mating blocks. Soundly engineered design, extra construction rigidity and positive accuracy provide for faster, better and more economical operation.

BUILDERS OF RAILROAD SHOP TOOLS SINCE 1861

BETTS • BETTS-BRIDGEFORD • NEWTON • COLBURN • HILLES & JONES • MODERN

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MACHINE TOOL CORPORATION

ROCHESTER 10, NEW YORK

HYCAR...a modern material for tomorrow's modern trains

There are important uses for HYCAR on every train...in every yard

TOMORROW'S trains, both freight and passenger, will be—above all—modern. They will be faster, safer, better-looking, more comfortable, more efficient, more dependable. They will also be more economical to operate, thanks in part to HYCAR synthetic rubber, a *modern* material that will contribute to the new efficiency and dependability.

The use of HYCAR has improved hose, gaskets and seals, bushings, vibration dampeners, mountings, diaphragms, window strips, floor mats, and dozens of other rubber parts. Wherever there is a resilient part—in train or yard—that's exposed to oil, dirt, abrasion, sun, heat, cold, or other destructive elements, that part should be made from HYCAR. HYCAR parts give dependable performance throughout a long life, and save money by reducing maintenance and replacement expense.

As suppliers only of raw synthetic rubber we make no finished parts of HYCAR. But we will be happy to cooperate with you and your supplier in the development of rubber products requiring specific combinations of the properties shown in the box at the right. For assistance in your problems write *Hycar Chemical Company, Akron 8, Ohio.*

CHECK THESE SUPERIOR FEATURES OF HYCAR

1. *EXTREME OIL RESISTANCE — insuring dimensional stability of parts.*
2. *HIGH TEMPERATURE RESISTANCE—up to 250° F. dry heat; up to 300° F. hot oil.*
3. *ABRASION RESISTANCE—50% greater than natural rubber.*
4. *MINIMUM COLD FLOW — even at elevated temperatures.*
5. *LOW TEMPERATURE FLEXIBILITY — down to —65° F.*
6. *LIGHT WEIGHT—15% to 25% lighter than many other synthetic rubbers.*
7. *AGE RESISTANCE—exceptionally resistant to checking or cracking from oxidation.*
8. *HARDNESS RANGE—compounds can be varied from extremely soft to bone hard.*
9. *NON-ADHERENT TO METAL—compounds will not adhere to metals even after prolonged contact under pressure. (Metal adhesions can be readily obtained when desired.)*

Hycar

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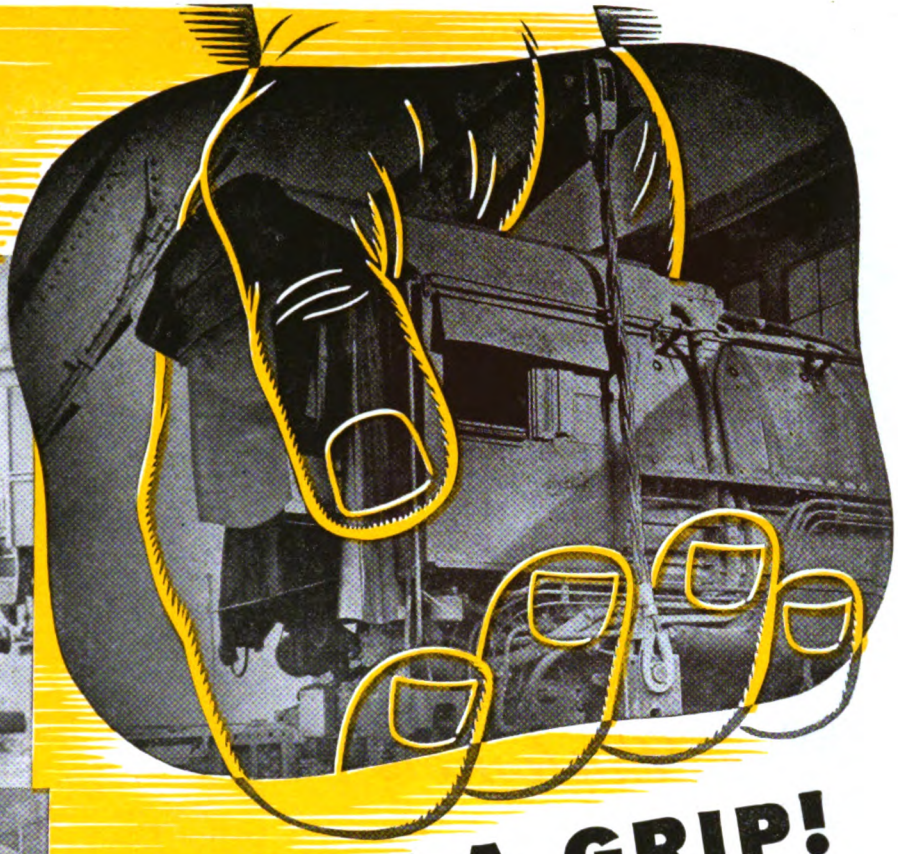
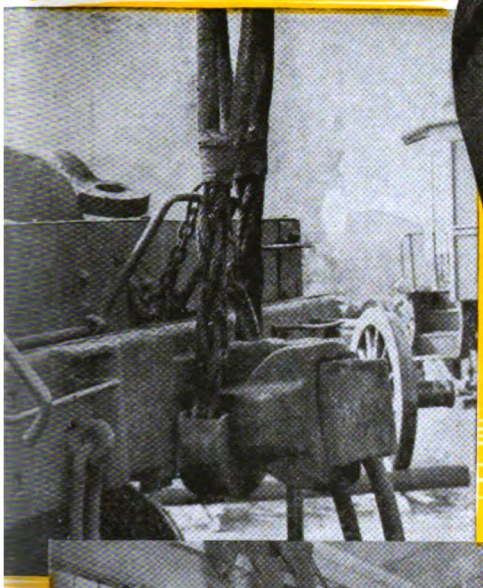
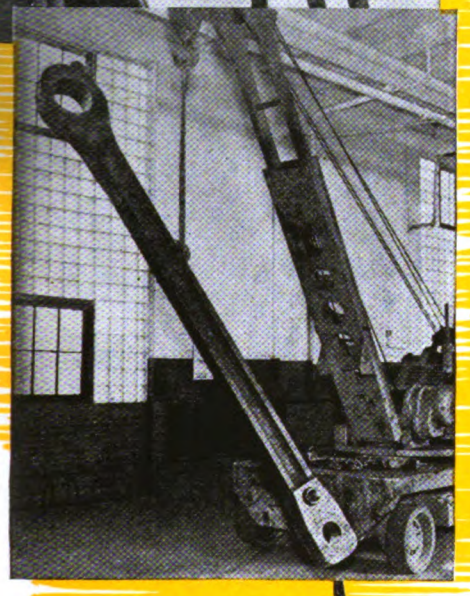
LARGEST PRIVATE PRODUCER OF BUTADIENE TYPE

Synthetic Rubbers







WHAT A GRIP!

Handle shop and derrick lifts safely with YELLOW STRAND *BRAIDED* SLINGS*

Scores of railroads have taken a fresh hold on the sling question as a result of wartime experience in shortening lay-up time. And what a grip *you'll* get by using Yellow Strand *Braided* Safety Slings in shops, yards, stores departments and on wreckers. Here you see such varied lifts as a steam locomotive, flat car (at the drawbar), main rod, pair of axles — and the list could include Diesel-electric bodies, motors, pistons, trucks, wheels, brake rigging assemblies and numerous other parts.

Tough Yellow Strand Wire Rope provides the strength in this efficient sling. The patented *braiding* adds flexibility, kink-resistance and a snug grasp on odd-shaped objects. The combined result is a time-and-labor-saving sling with less weight than chain of like capacity . . . with limberness well suited to Manila rope jobs . . . with greater security for men and loads.

Properly fitted, Yellow Strand *Braided* Slings will give long-lived, economical service. Write now for information. Broderick & Bascom Rope Co., St. Louis 15, Mo. *Branches:* New York, Chicago, Houston, Portland, Seattle. *Factories:* St. Louis, Seattle, Peoria.

RIGGERS' HAND BOOK FREE
Shows sling types, fittings, capacities. Write for your copy.

*PATENTS: U. S., 1475859, 1524671, 2142641, 2142642, 2299568, CANADIAN, 252874, 258068

ARMY E NAVY

BRODERICK & BASCOM

Yellow Strand

***BRAIDED* SAFETY SLINGS**

THE CHAMPION
RIVET COMPANY
CLEVELAND, OHIO
EAST CHICAGO, IND.

Keep that pencil sharp with FIRTHITE

Here's Why!

During the war it was a matter of *production speed* . . . and carbide cutting tools were the answer.

Today it's a matter also of keeping operating costs down. High production, yes . . . but at costs that meet or beat competition. Again Firthite sintered carbide tools will help you keep red ink out of your records, while turning out a better, more salable product.

if you have a tool or die problem

Call **Firth-Sterling**

STEEL COMPANY

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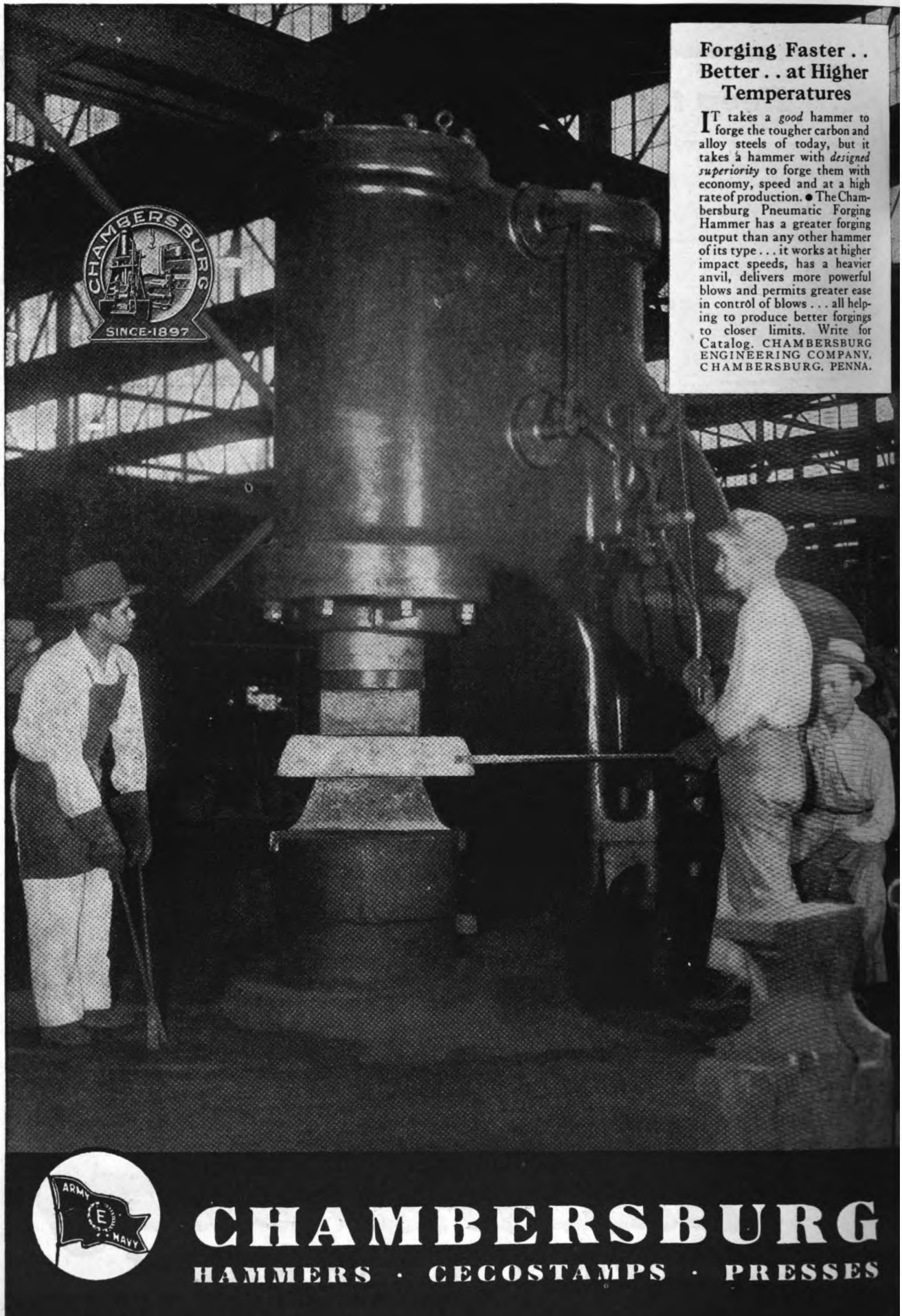
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SINCE-1897
Forging Faster . . Better . . at Higher Temperatures
IT takes a *good* hammer to forge the tougher carbon and alloy steels of today, but it takes a hammer with *designed superiority* to forge them with economy, speed and at a high rate of production. ● The Chambersburg Pneumatic Forging Hammer has a greater forging output than any other hammer of its type . . . it works at higher impact speeds, has a heavier anvil, delivers more powerful blows and permits greater ease in control of blows . . . all helping to produce better forgings to closer limits. Write for Catalog. CHAMBERSBURG ENGINEERING COMPANY, CHAMBERSBURG, PENNA.
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CHAMBERSBURG
HAMMERS · CECOSTAMPS · PRESSES

QUESTION:

Just how effectively can used oil be restored?

ANSWER: SO EFFECTIVELY THAT OIL NEED NEVER BE DISCARDED!

QUESTION: ***What Steps Are Necessary to Restore Oil for Re-Use?***

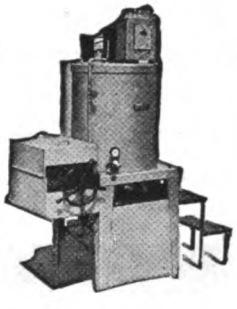
ANSWER: *For best results, the oil should be* heated, *to remove moisture and fuel dilution (if present). Then, solids, asphaltic materials and acids should be removed by contact with earth and filtration. Acidity should be reduced to new oil values.*

QUESTION: ***Can All These Steps Be Carried Out in a Single Piece of Equipment?***

ANSWER: *Yes, the YM Oil Refiner, a single self-contained unit, provides for* both *heating of the used oil, and for* two-stage *filtration.*

QUESTION: ***Is the YM Process Economical and Simple to Operate?***

ANSWER: *For every dollar spent for filtering materials, the YM method removes more pounds of contaminants than any other method known. Automatically controlled, the Oil Refiner needs little attention from the operator—no special skill is required.*



QUESTION: ***Is the Restored Oil Equal to New Oil?***

ANSWER: *Oil restored in the YM Oil Refiner can be used in the same manner and place as new parent oil. In fact, the restored oil, having been tempered, is frequently* more stable *than new oil.*

QUESTION: ***What Kinds of Oils Can Be Restored in a YM Unit?***

ANSWER: *Practically any kind used by industry. You'll find a helpful list in our YM bulletin—just mail the coupon for a copy. Or write us about your specific problem.*

THE YOUNGSTOWN MILLER COMPANY
A Subsidiary of Walter Kidde & Company, Inc.
1221 Kidde Avenue, Belleville 9, New Jersey

The Youngstown Miller Company
1221 Kidde Avenue
Belleville 9, New Jersey

Gentlemen:
Please send me further information about the YM Oil Refiner—and names of users in this locality.

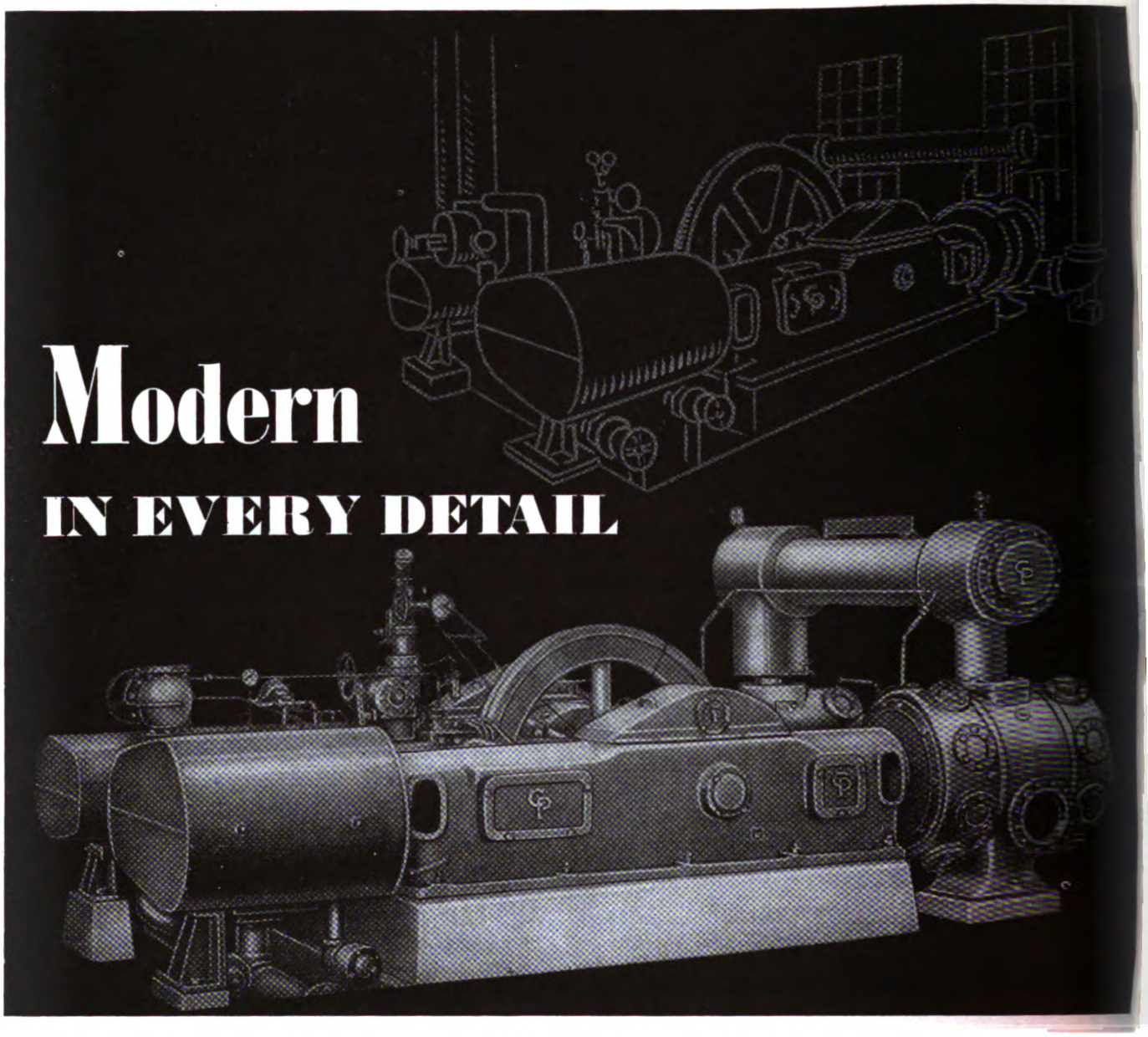
Name_____

Position_____

Company_____

Street Address_____

City and State_____



CLASS H STEAM DRIVEN COMPRESSOR

FORTY years of experience went into the building of CP Class H – latest model of CP Steam Driven compressors.

A thoroughly modern steam end, proportioned to the purchaser's steam conditions, combined with full force-feed lubrication of the running gear and a highly efficient air end with its Simplate Valves, all contribute to the high overall economy of these CP machines. The double crosshead-tie rod construction provides direct, straight-line transmission of power from steam end to air end. Capacities range from 400 to 6600 c.f.m., 100 to 125 pounds air pressure. Other sizes in single and multi-stage design tor lower and higher pressures. Write for literature.

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AIR COMPRESSORS
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FOR EFFICIENT MAINTENANCE OF AB BRAKES

This handy, compact Snap-on wrench set includes all tools needed for dismantling and assembling brake cylinders, and removing and applying AB valves and triple valves . . . *faster and easier!*

The advantages offered by this highly efficient kit over the hit-and-miss selection of ordinary tools are obvious. Proved in actual service . . . many shops are now standardizing on these sets for maintenance of AB brakes.

Write for further information on Snap-on AB kits. Snap-on offers a wide range of tools particularly adapted for railway maintenance operations. Complete catalog of 3,000 Snap-on tools on request.

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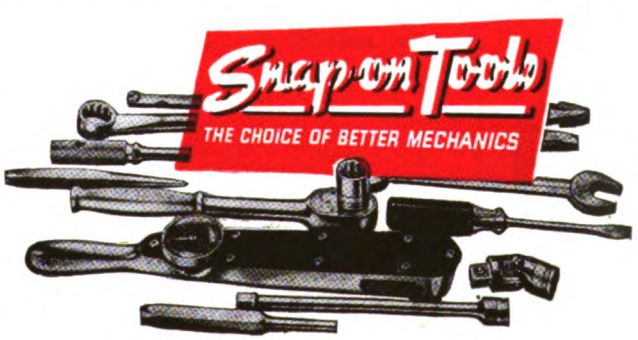
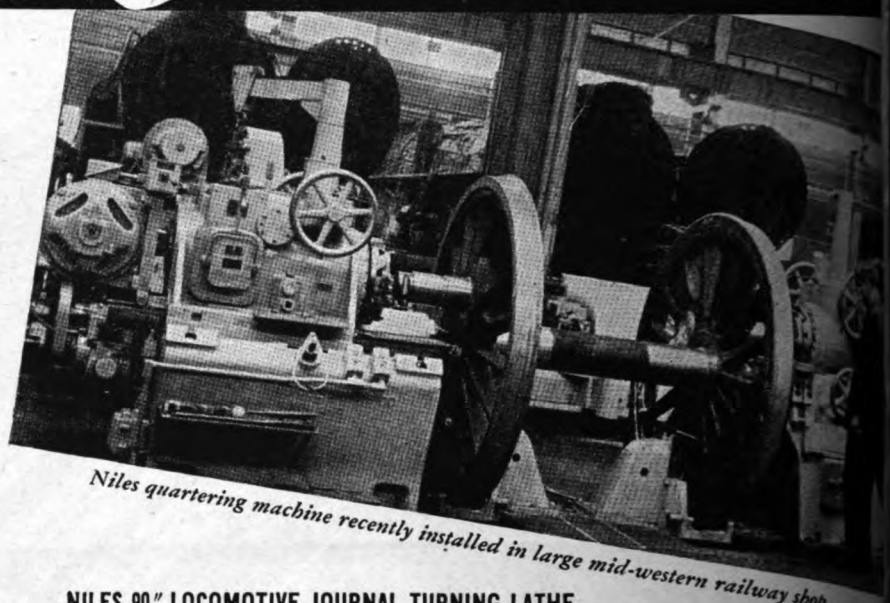


The Niles "BIG 3" for Locomotive Shops

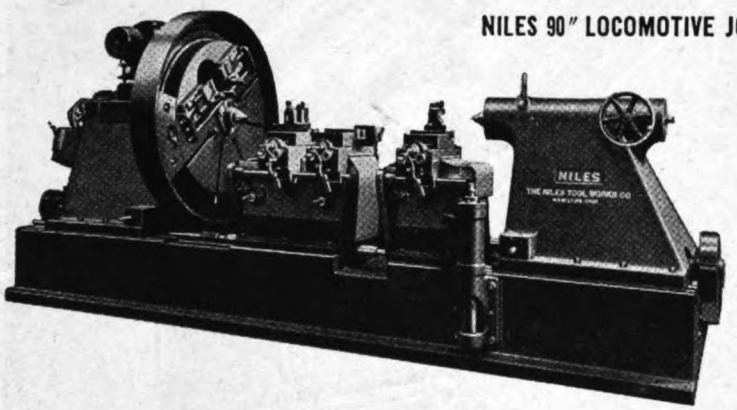
NILES 90" BALANCED QUARTERING AND PIN TURNING MACHINE

● Successful operation of locomotive crankpins depends upon accuracy of parallelism between the pin and axle, accurate quartering, accurate positioning for stroke, and lack of taper in the crankpins. The Niles 90" Balanced Quartering and Pin Turning Machine provides all these features.



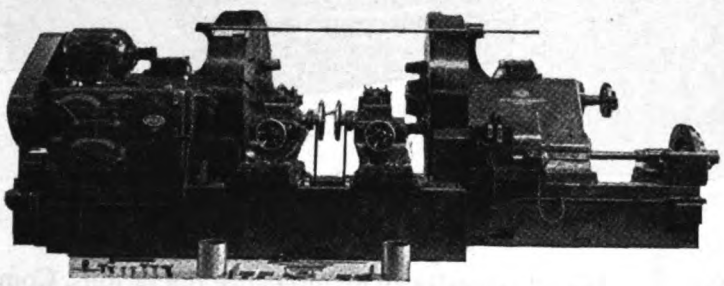
Niles quartering machine recently installed in large mid-western railway shop

NILES 90" LOCOMOTIVE JOURNAL TURNING LATHE



● Produces accurate and smooth journals on all classes of locomotive driving and trailer wheel sets. The two inside journals of driving wheel sets may be turned or burnished or both hub liners faced simultaneously.

NILES 90" HEAVY DRIVING WHEEL LATHE



Designed for the heaviest tread and flange contour turning duty with modern tool steels. Saves time, saves labor, gives maximum production with accuracies required for high speed locomotive operation.

NILES

Present-day high-speed operating schedules are possible and practical only when shop work has been held to the highest standard. Niles tools enable you to maintain this standard.

Write for catalog of Niles Railway Tools

★ Over 100 years experience building high quality into a vast quantity of machine tools.

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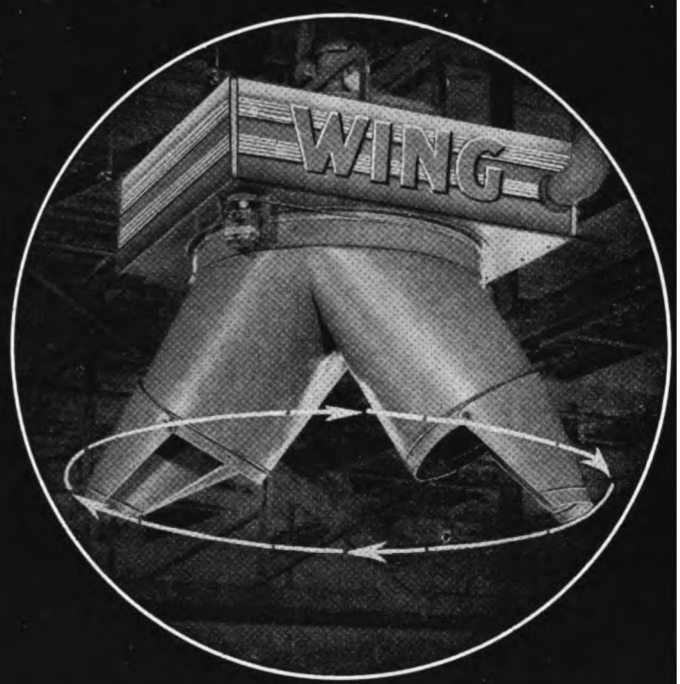
. . . the warmth-giving Sun . . . the life-producing Earth . . . the energizing Atom!

Like the sun, the earth, the atom, the Wing Unit Heater REVOLVES. It keeps the heated air in gentle motion, slowly circulating a constant, uniform, EVEN temperature, transforming hot and cold spots into comfortable, energizing, productive areas. The circulating heated air from the slowly revolving discharges reaches to farthermost corners, gets around and under obstructions, eliminates hot spots and cold spots.

Install Wing Revolving Unit Heaters now. Not only will they heat your plant comfortably and evenly, bringing a sensation of fresh, live, invigorating warmth to workers, but in the Summer, with the steam turned off and the fans on, they create a pleasant, cooling air motion over the entire area.

Write for Bulletin HR



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AID IN DEPENDABLE, ECONOMICAL
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The high quality, uniformity and dependability of Oliver bolts, nuts and rivets mean faster assembly, better joints. In building or repairing cars and locomotives, work goes faster when you use the proper types and sizes of accurately made, close-fitting Oliver fasteners.

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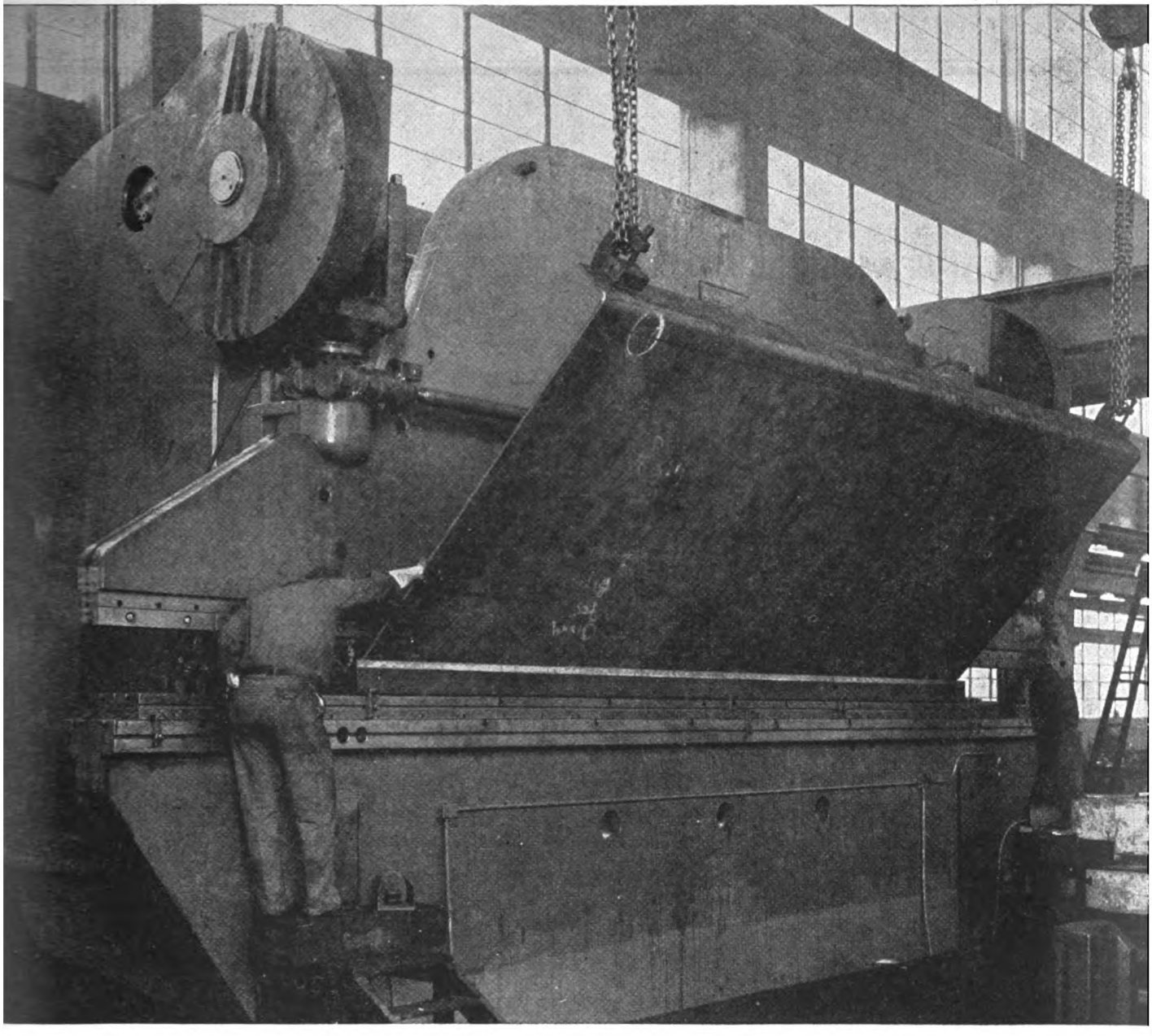


New manufacturing requirements have been met by the largest two housing mechanical brake in the world. Operating with machine tool accuracy, this Cincinnati Press Brake—weighing 125 tons with twenty feet between housings and thirty feet of over-all die surface—exerts 1000 tons pressure and in construction required the use of the largest rolled steel plates ever produced.

Write for our Catalog No. B-2 on Press Brakes and their many uses.

THE CINCINNATI SHAPER CO.

CINCINNATI OHIO U.S.A.

SHAPERS · SHEARS · BRAKES

THE EDITOR'S DESK

MANUFACTURERS' WAR RECORDS!

The general public is more or less acquainted with the truly remarkable contributions made by American railroads to the winning of the World War. It is not, however, so well informed as to the vital and, in many instances, dramatic part played by the railway supply manufacturers. For that reason it is hoped that more pithy and attractive publications, similar to the booklet issued by the American Locomotive Company, entitled, "American Locomotive Went to War", will be published.

In terse and well-illustrated form, it reviews briefly the high spots in its startling performance, covering the production of a wide variety of war products. During the first four years of the war it produced more than a billion dollars of materials, or more than during the first twenty-five years of the century. Its output in 1943 was eighteen times that of 1939.

These figures, while amazing, do not disclose adequately the achievements in manufacturing and engineering skill, which enabled this and other companies to develop and rush special equipment to the front in times of grave emergency. There is little question, for instance, but that the M-7 tanks, developed and manufactured at the Schenectady plant in record time, were an important factor in turning the tide against the Nazis in North Africa.

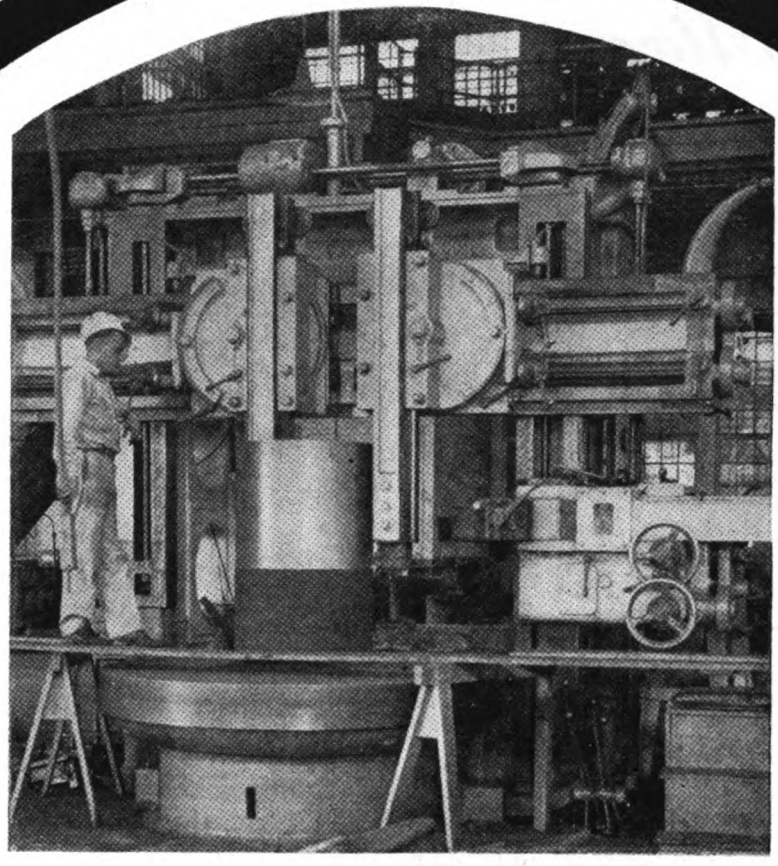
This is only one of many important performances which earned the Army-Navy E with Star and the Navy E with Star for the Schenectady Plant, the Maritime M with four Stars for Dunkirk, and the Army-Navy E with two Stars for the Latrobe Plant of the American Locomotive Company.

All honor to the railway supply manufacturers for the fine engineering and production contributions made in a time of crisis by an industry which ordinarily confines its attention in large measure to supplying the current needs of the railroads. The railroad industry—including both the railroads and supply manufacturers—has given an excellent account of itself in these critical war years.

Roy V. Wright

CYLINDER BUSHINGS

the KING way



THAT railroads are going "The King Way" more and more is exemplified again by the recent installation of this new 84" King double column Boring Mill in an important southern railroad shop.

While rugged construction, and their power and stamina to take the heaviest cuts at maximum speeds are outstanding features of all King Boring and Turning Mills, they are also accurate and produce a super-smooth surface machined to a micrometer fit.

The above illustration shows the King Mill boring and turning cylinder bushings 28½" O.D. — 27" I.D. and 42½" long.

The machine, which is fitted with three heads, ram, turret and side, will take the heaviest cuts at highest speeds which the best cutting tools will withstand when machining jobs within capacity. You can obtain King Heavy Duty Double Column Mills from 52" to 144" swing — either with or without side heads.

The KING MACHINE TOOL Company

BUILDERS OF VERTICAL BORING AND TURNING MACHINES EXCLUSIVELY

CINCINNATI, OHIO

SEMPER FIDELIS

Always faithful to 'round-the-clock duty . . . . . thanks to Dearborn

Even now, the railroads, which have served our country so well, cannot relax. Their locomotives still must meet strenuous traffic demands during military demobilization.

Over 200 railroads employ Dearborn water treatment and service. We, at Dearborn, are justifiably proud of our share in keeping locomotives full of energy for continuous duty . . . with boilers free from scale, corrosion, and foam.

Frequent analyses of feedwater, chemical formulas to meet conditions at each water station, supplemented by scientific control work in the field, bring about the desired results . . . no extensive time out for boiler washouts or boiler repairs due to basically bad water.

The Dearborn engineer will be glad to discuss water treatment for your road. You can keep boilers free from trouble; locomotives . . . always faithful.

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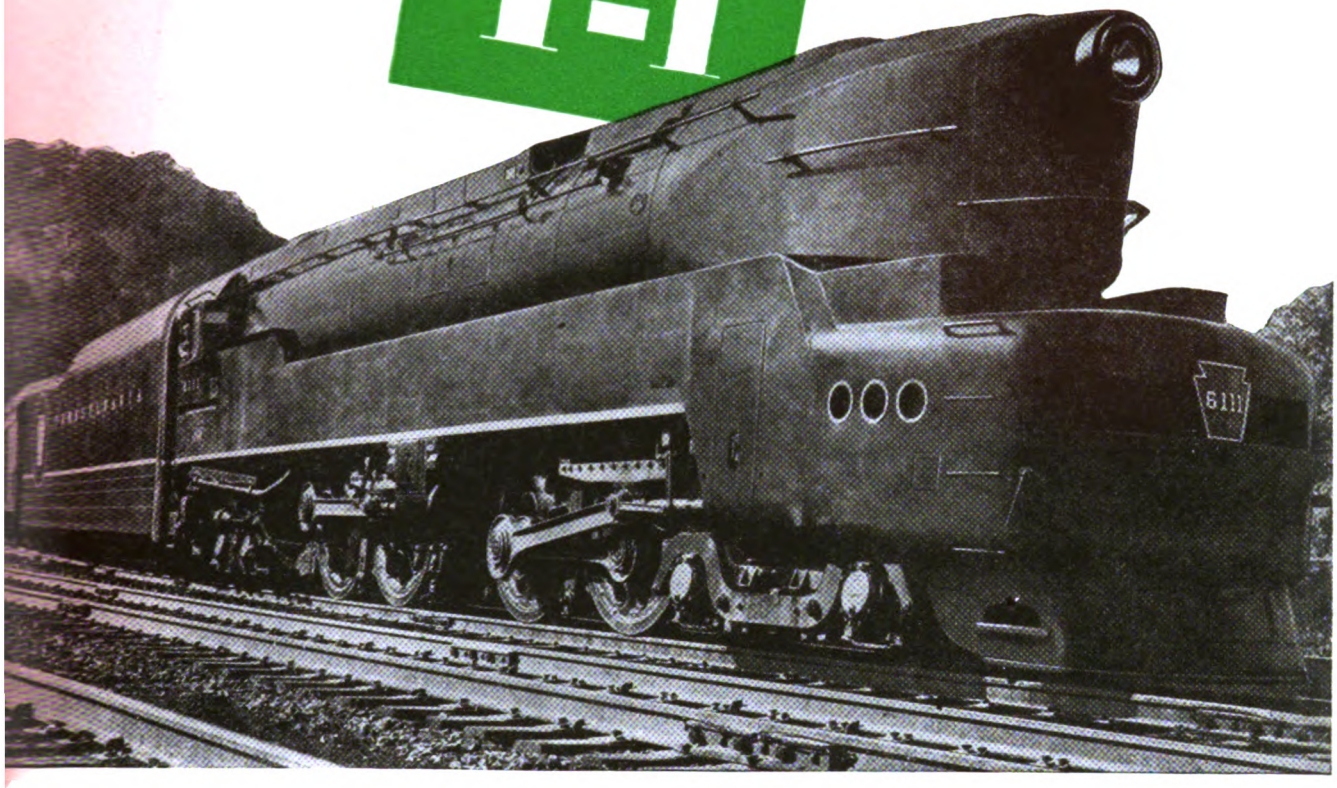

is equipped with SECURITY CIRCULATORS

That Security Circulators are recognized as an important contribution to modern locomotive design is shown by their use in The Pennsylvania Railroad's famous T-1 class locomotives, each of which has five circulators in the firebox.

AMERICAN ARCH COMPANY, INC.

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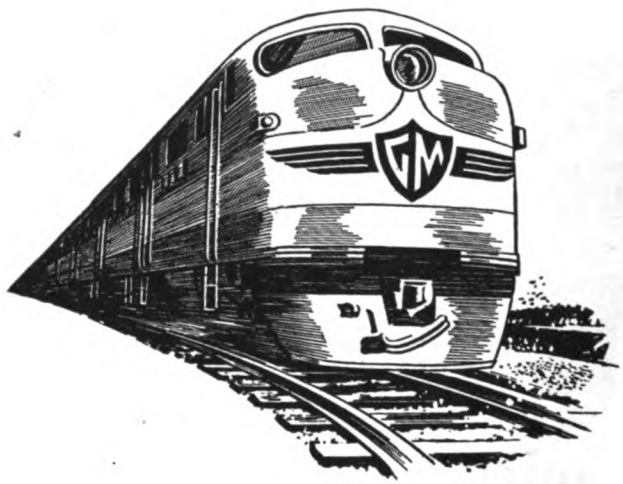
SECURITY CIRCULATOR DIVISION

IT'S A GREAT NEW DAY FOR RAILROADING

ESSENTIAL IN WAR



ESSENTIAL IN PEACE

GM LOCOMOTIVES

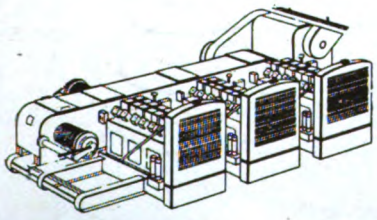
How to Put the
"EASY TOUCH"

on Diesel Road Locomotives

THE "*easy touch*" on the road locomotives means finer control of power and smoother starting by means of the pneumatic throttle. With the engine idling, setting up of electrical circuits and regulation of engine speed are governed by the control handle. In the starting zone, engine speed is held constant and the field resistance cut out gradually until full power intensity is applied.

As the handle is advanced further, the pneumatic throttle cuts in and increases engine speed progressively. Operation is interlocked with the reverser handle so that the reverser cannot be moved to change direction unless the control handle is moved to "off" position. Smooth starting, precise engine control and direction interlocking are characteristic of the pneumatic throttle — single handle control.

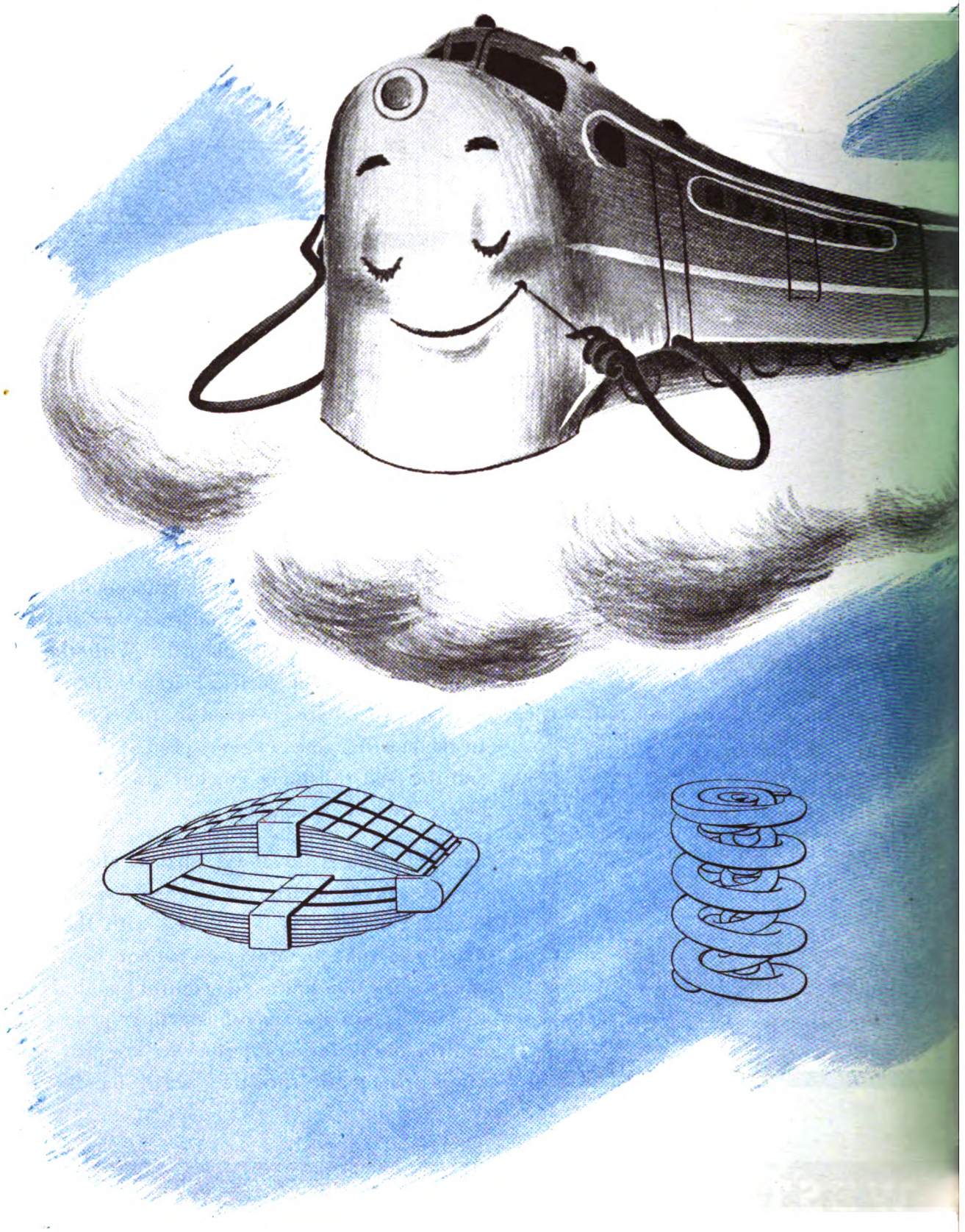
The pneumatic throttle, as used on all classes of steam and Diesel locomotives, has demonstrated a wide utility for stationary and marine Diesels. An interesting application is on oil rigs where three Diesels work together on hoisting operations. The pneumatic throttle synchronizes engine output by maintaining balanced fuel supply to all three engines.



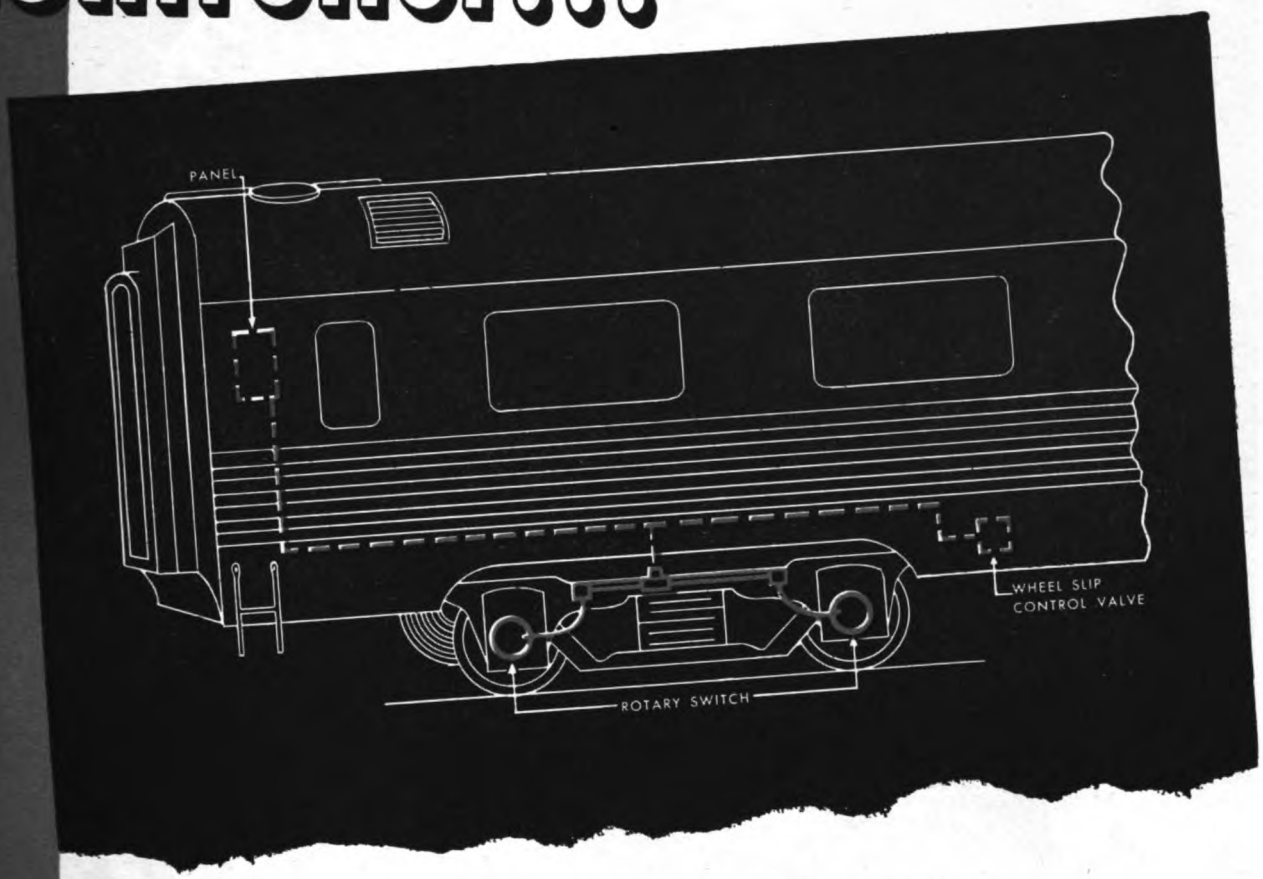
WESTINGHOUSE AIR BRAKE CO.

WILMERDING, PENNSYLVANIA

Railroad Popularity Rides On Springs



Controller...



RELIABILITY ITSELF
in prevention of slid flats

• The American Brake Shoe Controller is positive in its detection of wheel slippage . . . instant in its correction . . . unfailing in its restoring of full brake as soon as slippage is eliminated.

• Passenger Traffic and Operating officials welcome the availability of equipment made possible by the use of the American Brake Shoe Controller, proved by years of successful performance on high speed passenger trains.

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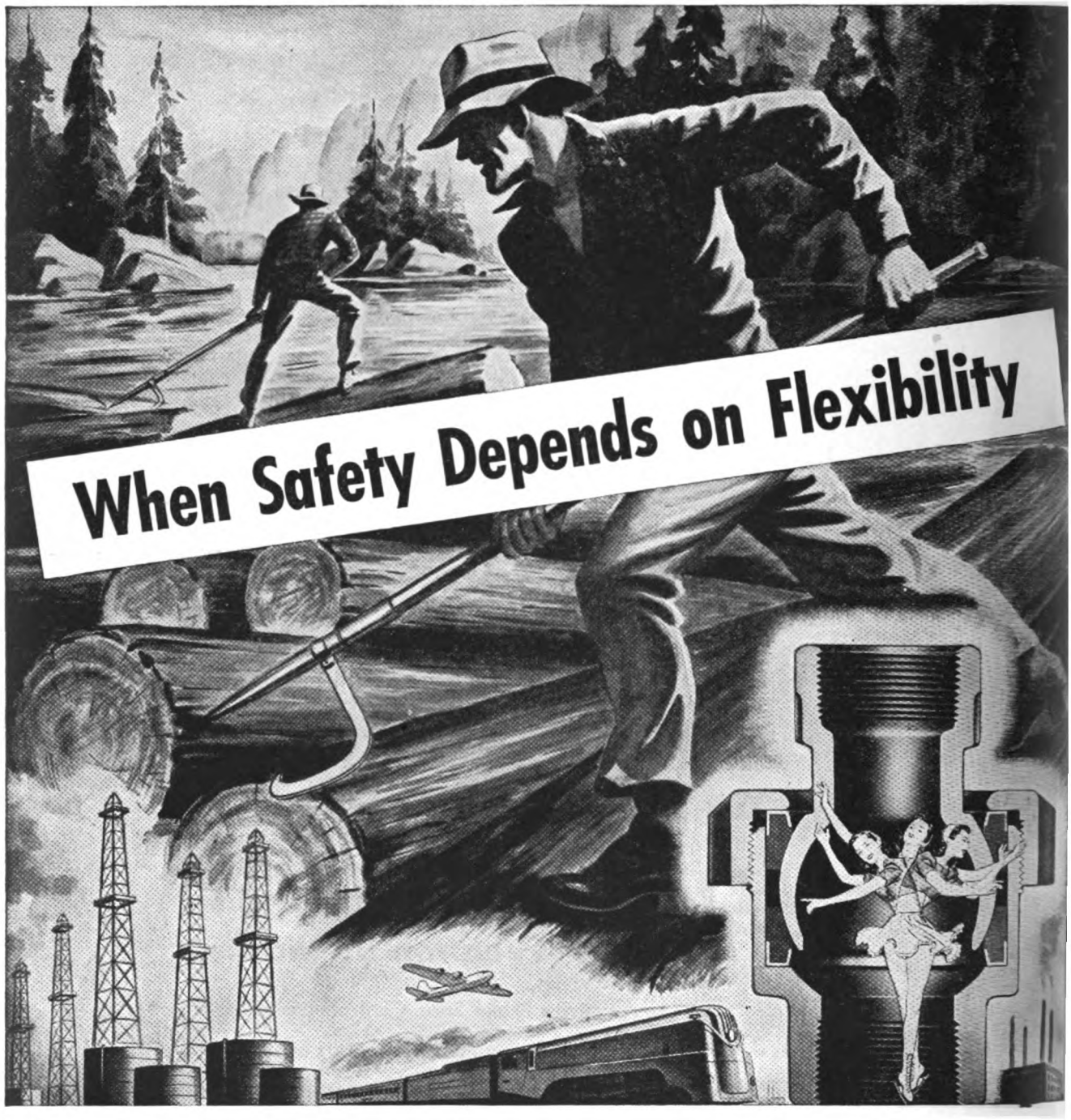
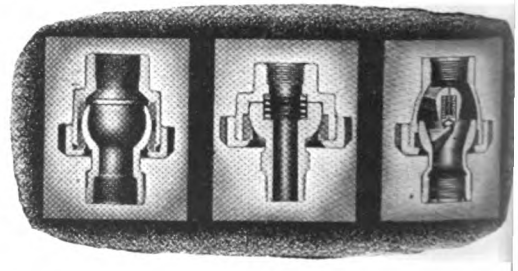


Quick responsive movement is the natural safeguard against sudden strains and shocks. Barco Flexible Joints are designed to provide compensation for movement always present in fluid-conveyor systems...counteracting destructive vibration, expansion and contraction. Today, as for the past 30 years, engineers and designers throughout industry and transportation look to Barco for solution to their flexible joint problems. Write to Barco Manufacturing Co., Not Inc., 1808 Winnemac Ave., Chicago 40, Illinois.



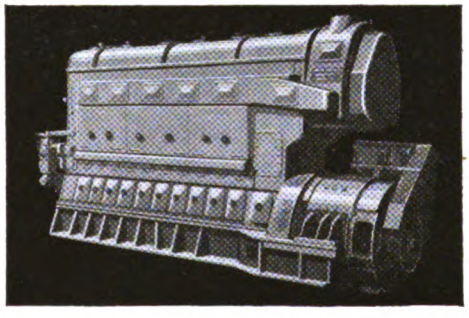
BARCO FLEXIBLE JOINTS

Not just a swivel joint...but a combination of a swivel and ball joint with rotary motion and responsive movement through every angle.

FREE ENTERPRISE—THE CORNERSTONE OF AMERICAN PROSPERITY

In Canada: The Holden Co., Ltd., Montreal, Canada "MOVE IN EVERY DIRECTION"

TOMORROW'S POWER TODAY!

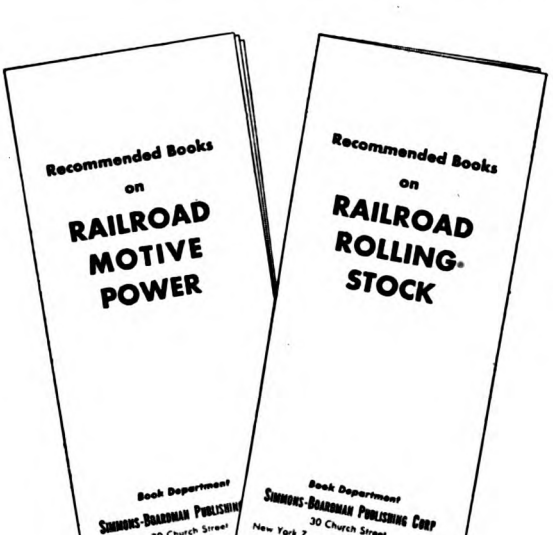


It's the
Full-Power
Diesel Locomotive
by

FAIRBANKS-MORSE

A NAME WORTH REMEMBERING

FREE ON REQUEST



There are now three of these helpful lists of books on Motive Power, Rolling Stock, and Engineering and Maintenance, which are free on request. They are uniform in size, 3½ x 8 inches, and each describes from 60 to 80 titles of all publishers. Send for your copies today.

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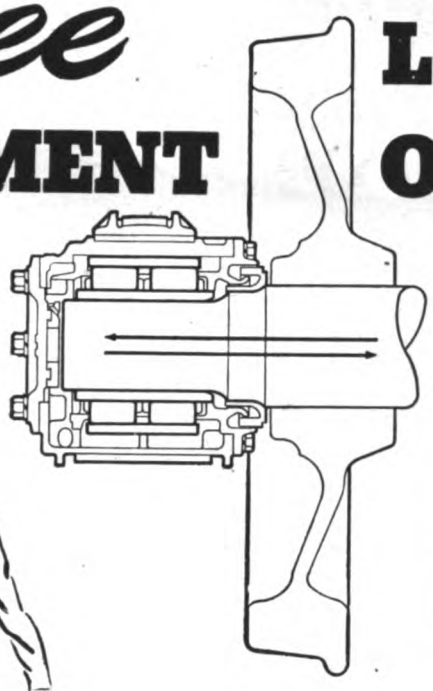
Respect its wearer, whoever he or she may be, for it represents an honorable discharge from the armed forces of the United States . . . *for a job well done.*

Free LATERAL MOVEMENT OF AXLES



"Free lateral" is not a common trade name—it is distinctly applied to Hyatt Journal Boxes.

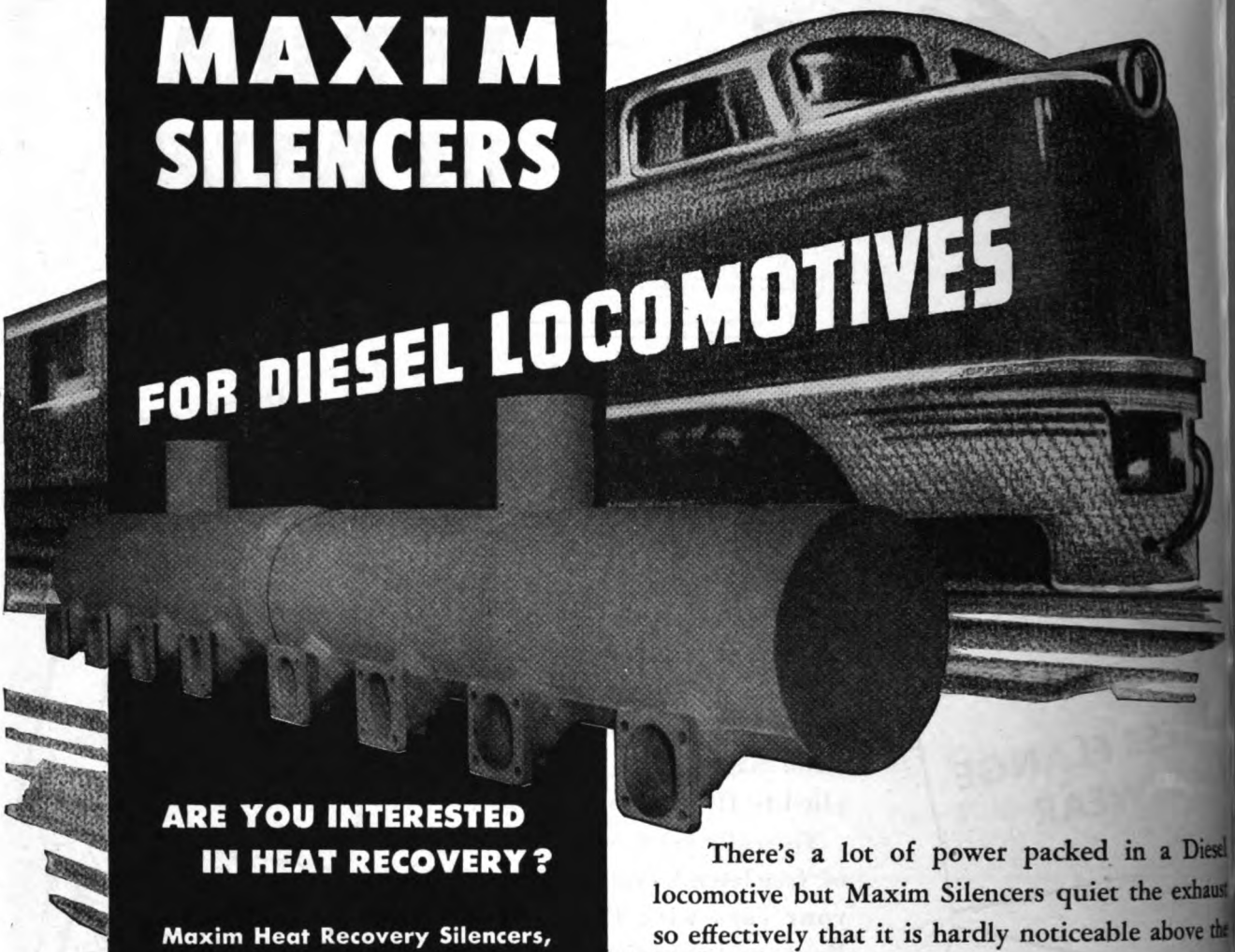
To really get the true meaning of "free lateral," you have to equip your cars with Hyatt Journal Boxes and experience their many advantages.

The operators of the many railroads running Hyatt-equipped cars and Diesel locomotives have proved to their profit and satisfaction the full meaning of "free lateral movement of axles."

A new booklet—just off the press—gives the experiences of Southeastern roads using Hyatt-equipped journal boxes. Write for your copy. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARING RAILROAD JOURNAL BOXES

MAXIM SILENCERS FOR DIESEL LOCOMOTIVES



ARE YOU INTERESTED IN HEAT RECOVERY?

Maxim Heat Recovery Silencers, in addition to providing effective silencing and, where necessary, spark arresting, also recover waste exhaust heat to produce steam or hot water for heating purposes. Maxim engineers will be glad to discuss possible applications to your problems. Send for Heat Recovery Bulletin WH 101.

There's a lot of power packed in a Diesel locomotive but Maxim Silencers quiet the exhaust so effectively that it is hardly noticeable above the low rumble of wheels, clicking rail joints, etc. Good public relations demand this type of silencing when yards or right-of-way lie in or near business or residential sections.

The illustration shows Maxim exhaust manifold silencers which replace the conventional exhaust manifold and thus provide considerable saving of space. Standard Maxim exhaust silencers are also used in Diesel locomotives, and, in fire hazard areas such as refineries, ordnance plants, lumbering operations, etc., are equipped with the Maxim Spark Arrestor which traps 100% of the exhaust sparks.

THE MAXIM SILENCER COMPANY • 65 HOMESTEAD AVE., HARTFORD, CONN.

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MAXIM

American Hammered

PISTON RINGS

in every size . . . of every type

for every purpose

AVAILABLE NOW!

You can get all the American Hammered Piston Rings you need, in any size . . . of any type . . . for any purpose . . . just as promptly as you did in pre-war years.

You'll find that these new rings reflect a quarter-century of peacetime skill and experience and *another* quarter-century of experience and progress that was crowded, by the needs of the nation, into five years on the calendar.

Wartime accomplishments include the production or perfection of such revolutionary new developments as the wear-banishing "PORUS-KROME" *treatment, and the life-extending, performance-boosting high-tensile alloys.

Let us demonstrate that now as in the past, American Hammered Piston Rings plus American Hammered engineering service give the answer to every ring need.

KOPPERS COMPANY, INC.

American Hammered Piston Ring Division

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* VAN DER HORST PROCESS

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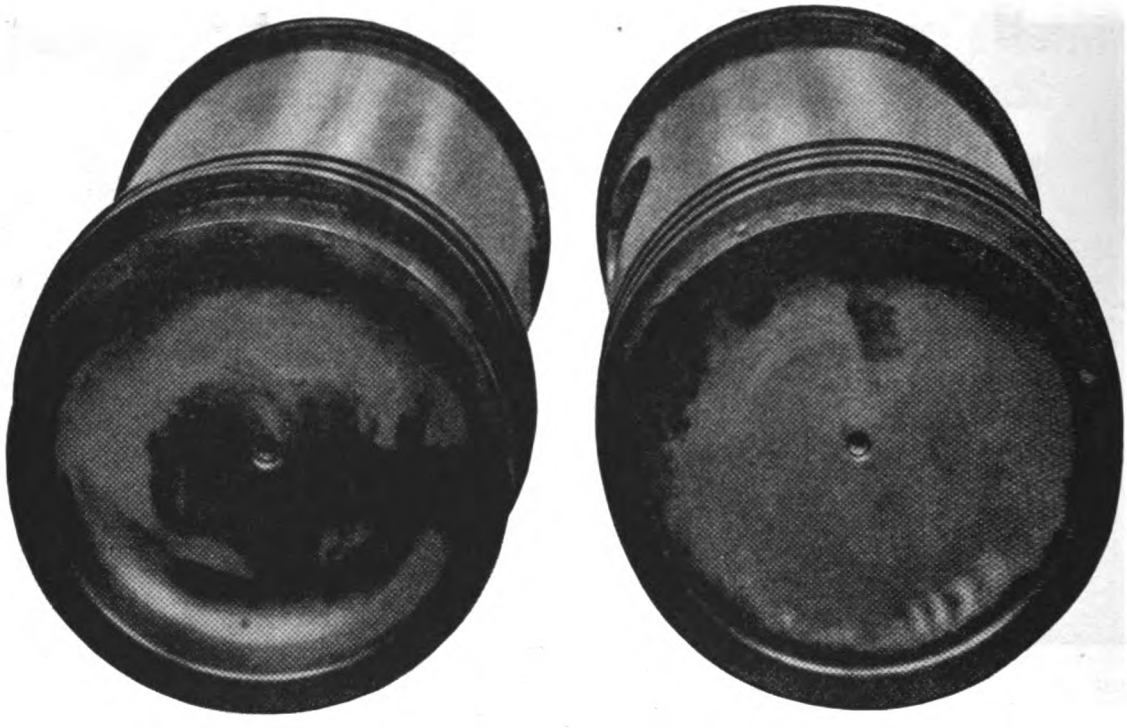
THE INDUSTRY THAT SERVES ALL INDUSTRY

NO HARD CARBON

all rings free after 157,076 miles!



Rock Island "Rocket" Test Shows Efficiency and Economy of RPM DELO Oil

There were no oil changes—RPM DELO Diesel Engine Lubricating Oil was added only as required for make-up. At the end of the test all rings were free, ports unclogged . . . because the inhibiting, detergent and peptizing properties of RPM DELO Oil prevent formation of hard or abrasive carbon. Wear on engine parts, liners, rings and pistons was reduced, entire engine assembly was definitely cleaner, lubricating costs were markedly reduced.

RPM DELO Oil will prove superior in your service, too. Get full information from your RPM DELO Oil Distributor, or write for details.

RPM DELO
DIESEL ENGINE LUBRICATING OIL

Write on your letterhead for free booklet on RPM DELO Oil to Standard of California, Dept. R-1, 225 Bush St., San Francisco 20, Calif., or California Commercial Co., 30 Rockefeller Plaza, New York 20, N. Y.

STANDARD OF CALIFORNIA

RPM DELO Oil has world-wide distribution under the names: RPM DELO, Caltex RPM DELO, Kyso RPM DELO, Signal RPM DELO, Imperial RPM DELO (CONCENTRATE)

CHRISTMAS *and* TRAINS GO TOGETHER!

PHOTO COURTESY THE LIONEL CORPORATION

Railroading is always close to the hearts of American boys and men. In the glow of Christmas, when families gather for fun and feast, the toy railroad is a center of interest for young and old. For railroads are an exciting, romantic part of our civilization. Their history is the history of the nation. Their work keeps millions on farms, in factories, offices . . . everywhere . . . busy.

Let's encourage model railroaders. Their pastime interest may well lead to a lifetime loyalty in railroad work.

HY-PRESSURE
HY-CROME
"Edgemark of Quality"

EATON
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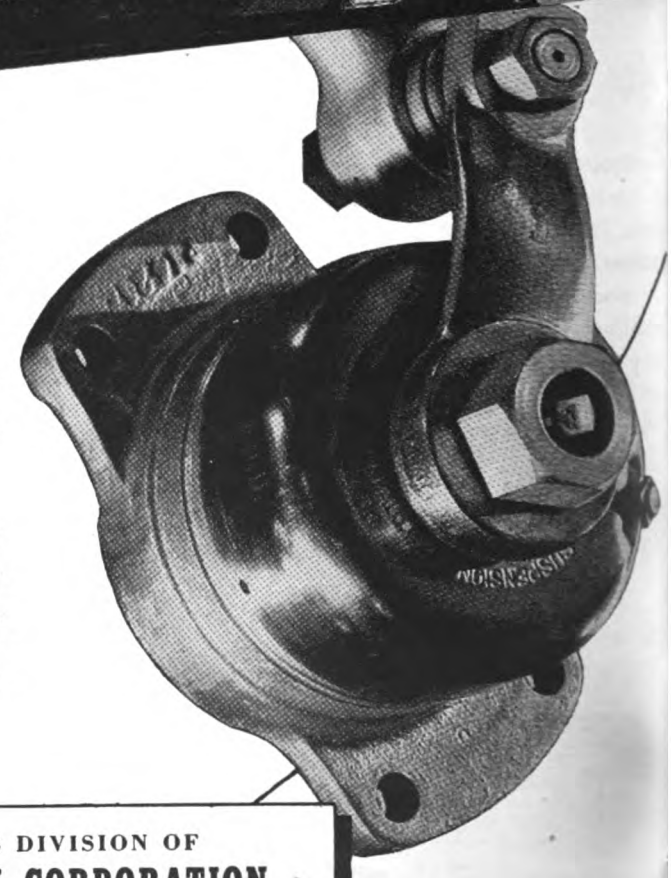
HYDRAULIC COMFORT For BURLINGTON'S NEW VISTA DOME CAR

● Luxurious riding qualities will be a Houdaille* contribution to Burlington's thrilling new Vista Dome Car.

Improved Houdaille hydraulic instruments will provide *both* lateral and vertical control.

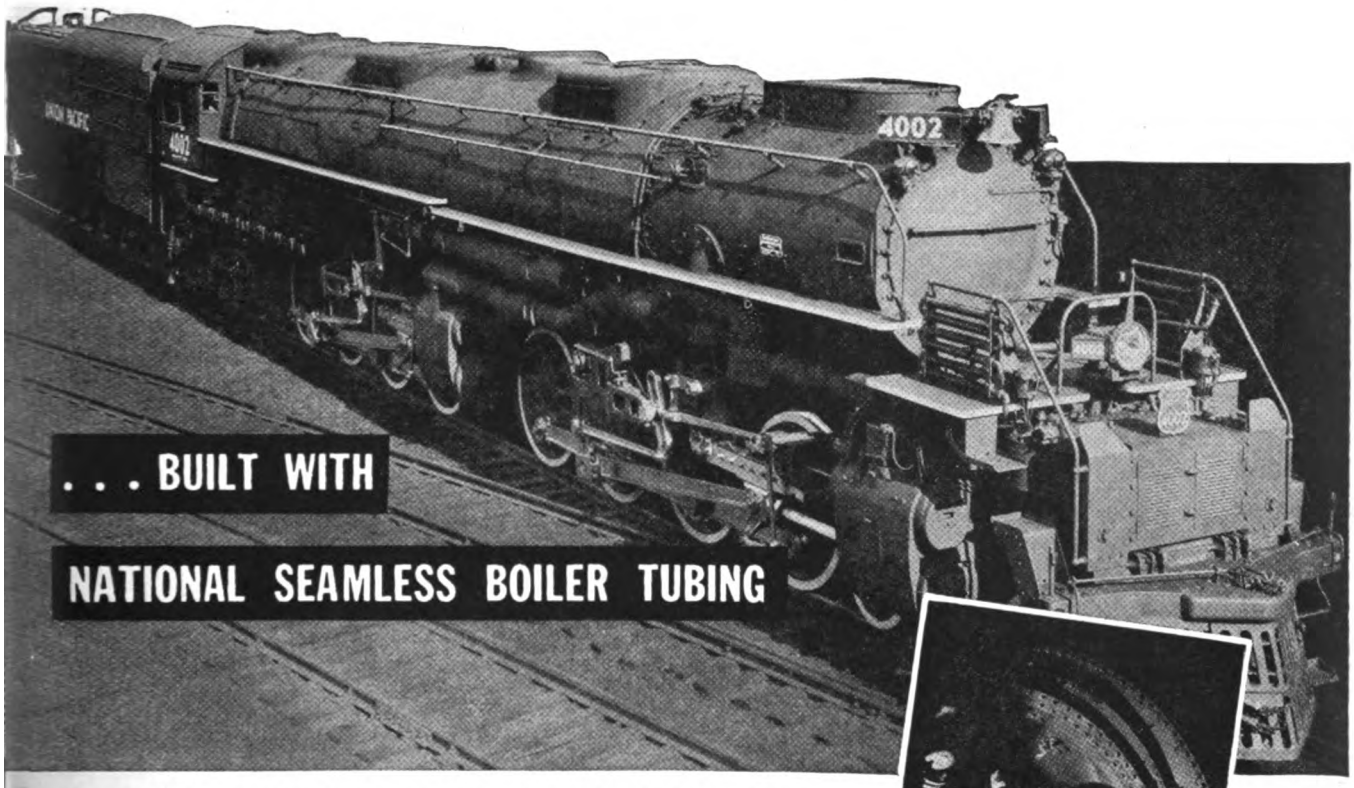
Houdaille Railroad Shock Absorbers stabilize and cushion the operation of America's most famous trains, many of which have seen more than a million miles of service.



HOUDE ENGINEERING DIVISION OF
HOUDAILLE-HERSHEY CORPORATION
MAKERS OF HYDRAULIC CONTROLS
BUFFALO 11, NEW YORK

*Pronounced—Hoo-dye

The "Big Boys" came through in the pinch



Backbone of the Union Pacific's fleet of freight locomotives are these 4-8-8-4 type "Big Boys" which were equipped with NATIONAL Seamless Boiler Tubes.

MORE tonnage has been hauled on American railroads in the last five years than in any similar period in history. On the Union Pacific a huge fleet of these "Big Boys" shouldered a lion's share of materials over the "Rockies."

In this grueling service, NATIONAL Seamless Boiler Tubes set an amazing record for reliability. They helped to keep the "Big Boys" on the job and out of the repair shops.

On railroad after railroad, shop superintendents have told us how NATIONAL Seamless represents the ultimate in the manufacture of boiler tubes. The reason for this is not hard to find. Only the best steel can be used in the seamless process. The piercing operation is in itself an exploratory test and would bring to light the minutest defect in the steel used in manufacturing the tube. Seamless tube walls are uniform . . . there is no longitudinal weld that might offer a starting point for failure. As a result, Seamless Boiler Tubes are as near perfect as any that can be made.

In the years ahead, the savings made possible by NATIONAL Seamless Boiler Tubes will be well worth considering. Write for more information on your next job.

RE-TUBE WITH NATIONAL SEAMLESS

ADVANTAGES OF NATIONAL SEAMLESS BOILER TUBES

Seamless—No uncertainty about full wall strength in every tube.

Higher Creep Strength—only "killed" open hearth and electric furnace steel used.

Uniform Density and Soundness — improved heat transfer characteristics.

Exceptional Ductility — every tube completely annealed — readily manipulated — lowest installation costs.

Thorough Uniformity—assured by careful metallurgical supervision.

Over 50 years' proved performance under exacting service. Comply with all recognized specifications —water-tube or fire-tube boilers.

WALLS WITHOUT WELDS

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Tubing Specialties Division

NATIONAL TUBE COMPANY USS STEEL UNITED STATES STEEL

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

HOME for them!

and the HOME STRETCH for YOU!

You still have time! In December, your employees' allotments to the Victory Loan through your company's Payroll Savings Plan offer a final chance to help speed the proud homecoming of our fighting men—and do all in medical power for our hospitalized heroes!

Make December a plantwide TOP-THE-QUOTA drive! Now's the time to spotlight your Payroll Savings Plan—and "brief" your Bond-selling organization for fast, last minute action!

***Resolicit every employee to buy the* New F.D.R. Memorial $200 Bond**

The new Franklin Delano Roosevelt $200 Bond—better than actual cash because it earns interest—is a strong building stone toward the secure future of every employee-purchaser!

From now 'til the New Year—with plant rallies, interdepartmental contests and resolicitation—keep Payroll Savings Plan Bond-buying at a new Victory Loan high! Buying a Victory Bond is the best way of saying "Welcome Home" to our returning veterans! Also an active aid in assuring prosperity to your nation, your employees—and your own industry!

VICTORY LOAN

The Treasury Department acknowledges with appreciation the publication of this message by

RAILWAY MECHANICAL ENGINEER

This is an official U.S. Treasury advertisement prepared under the auspices of the Treasury Department and War Advertising Council

OPPORTUNITY FOR CAR DESIGNERS TO STEP UP PAYLOAD

with one of Republic's

3 HIGH STRENGTH STEELS

That's one big reason why these strong, tough steels were developed —to help designers of railroad equipment to convert profit-eating deadweight into money-making payload.

And here is how it's done.

Republic High Strength Steels have a minimum yield point of 50,000 pounds per square inch which, combined with essential resistance to atmospheric corrosion, permits the use of thinner sections without sacrifice of service life.

In a hopper car this means greater payload capacity without increase in deadweight. In a box car it means more payload per pound of deadweight, or less power consumed per ton-mile of paying freight. Experience has proved that the use of Republic High Strength Steels throughout freight car bodies can result in a deadweight reduction of 25% — and, also, in substantially-reduced maintenance costs.

So that designers and builders may realize greatest benefits, Republic produces three high strength steels —Republic ALDECOR, Republic COR-TEN and Republic DOUBLE STRENGTH in sheets, strip, plates and bars. Although similar in physical properties, certain differences in forming and welding characteristics may make one more suitable for you than the other two.

Republic's metallurgical staff is ready now to work with you in determining how best to use these steels in replacing obsolete, cumbersome equipment with stronger, lighter cars of all types.

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Bldg., New York 17, N. Y.

Republic

HIGH STRENGTH STEELS

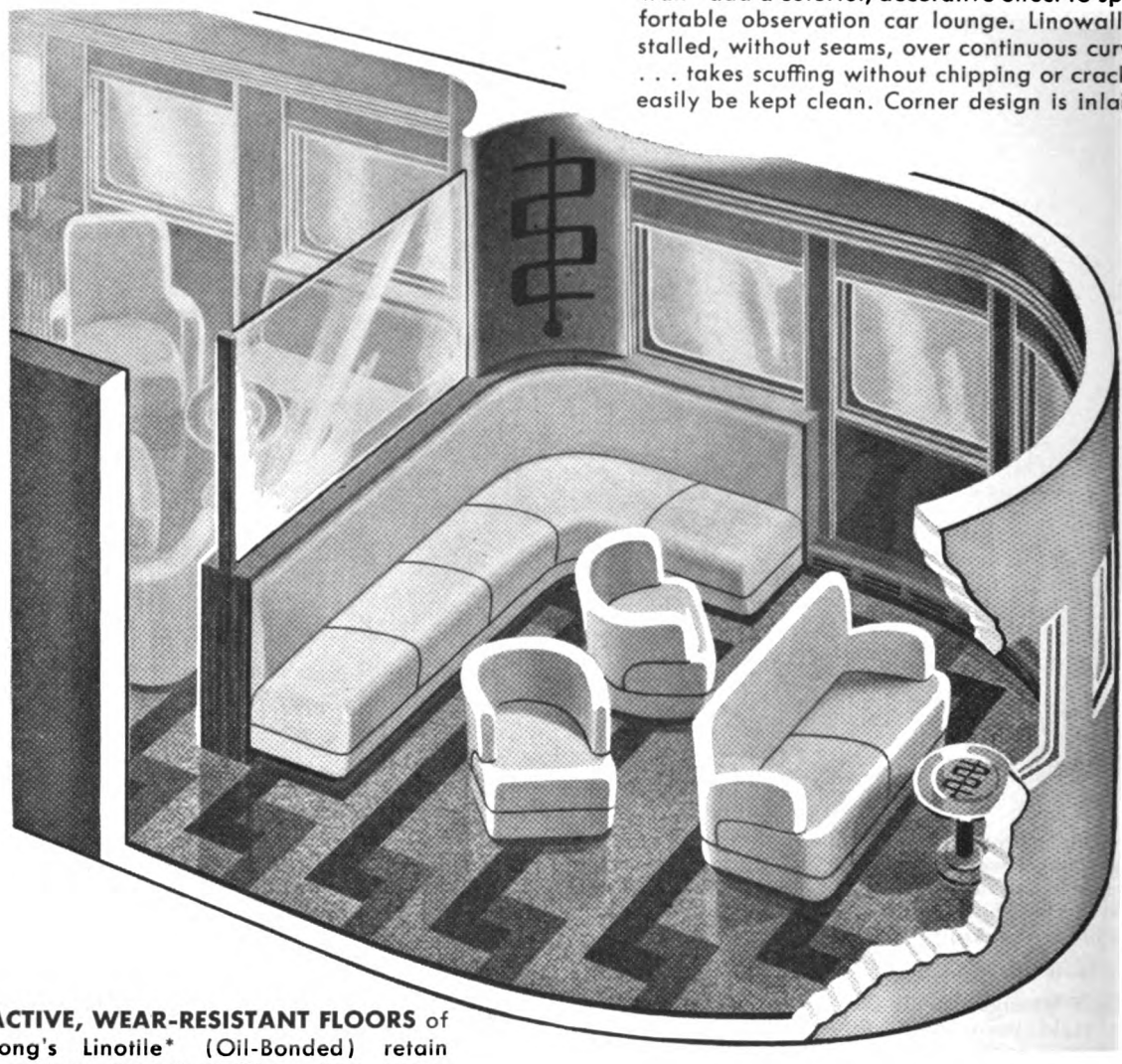
ALDECOR • COR-TEN • DOUBLE STRENGTH

Other Republic Products include Carbon, Alloy and Stainless Steels — Sheets — Plates — Pipe — Bolts, Nuts and Rivets — Boiler Tubes

ADVANCE STYLE NOTES FOR PASSENGER CARS

Observation Cars

STREAMLINED sidewall surfaces of Armstrong's Linowall* add a colorful, decorative effect to spacious, comfortable observation car lounge. Linowall can be installed, without seams, over continuous curved surfaces . . . takes scuffing without chipping or cracking . . . can easily be kept clean. Corner design is inlaid.



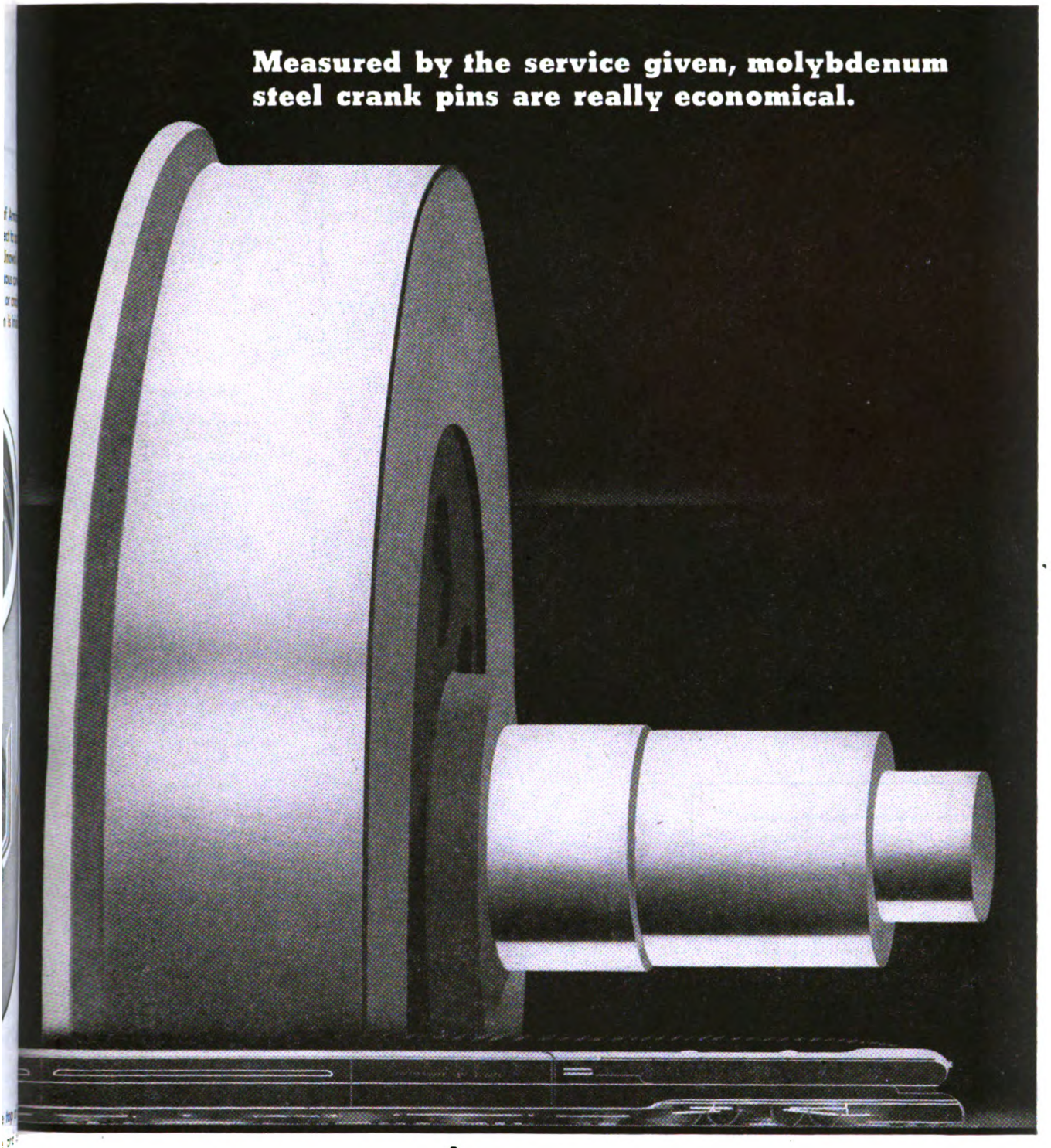
ATTRACTIVE, WEAR-RESISTANT FLOORS of Armstrong's Linotile* (Oil-Bonded) retain beauty and smartness for millions of passenger miles, provide a wide variety of design possibilities. Top-set cove base facilitates cleaning. Armstrong's Cork Base Underlayment saves weight, resists indentation, can be used over any type of floor plate.

DECORATIVE, SERVICEABLE table top of Armstrong's Linoleum carries out color scheme and appointments of car section. Designs inlaid in linoleum offer unlimited possibilites for unusual decorative patterns. Damp cloth quickly removes dirt and crumbs.

* Reg. U. S. Pat. Off.

PUT ARMSTRONG'S versatile floor and surfacing materials into your car designs. They will help you achieve striking, durable interiors in every type of passenger car. For full information and free samples of Armstrong's Linowall, Linoleum, and Linotile, write to Armstrong Cork Company, Industrial Division, 7412 Arch Street, Lancaster, Pennsylvania.

ARMSTRONG'S
FLOORS and SURFACING MATERIALS
for passenger cars



LIMAX FURNISHES AUTHORITATIVE ENGINEERING ATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Molybdenum Company

500 Fifth Avenue · New York City

MOLY

POINTED RHYMES FOR TRYING TIMES

by
Berton Braley

Here is wisdom by the peck
Versified to save your neck!

DON'T BLOW IT

Oh, workman or scholar,
Hang on to your dollar
And do not spend it soon,
For every cent
Unwisely spent
Inflates the price balloon.

IT MAKES SCENTS

To market (black market) to spend lots of jack
Careless of how many ceilings you crack,
To market (black market) where prices are dear,
—Gosh, there's a terrible smell around here.

If

If you can keep your head and calmly ponder
How silly spending drives the prices high;
If you can save the cash you'd like to squander
And only buy the things you need to buy;
If you can do your part to fight inflation
By simply being thrifty with your pelf,
You'll do a vital service to the nation
And—furthermore—you'll benefit yourself.

Bonds you buy with payroll earnings,
Help fulfill your future yearnings.

NO GAMBLE

When the war is over, will the prices
rise or fall?
We do not know the answer, and
nobody does, at all.
But this much we *can* prophesy—
whichever way they go:
You will find it more convenient if
you've saved a little dough.

★ ★ ★

Money in your pocket,
Take it out and sock it
Into War Bonds, which
Help to make you rich.

DOUBLE AND NO QUITS

When you boost your paycheck quota and allot it
To another bond—it's pretty soft for you!
For, although you've spent your money—you
have got it,
And the Interest is interesting too.

WHO? ME?

There was a little dope with a fat
pay envelope
And she spent every cent that
was in it.
And she wondered, by-and-by,
why the prices rose so high,
But she didn't blame herself for
a minute.

★ ★ ★

INFLATIONARY MARY

Inflationary Mary spills
This silly kind of chatter:
"My little teeny-wee bills
And spendings do not matter.

"And if I cheat a little bit
On rationing and ceilings
The Nation's welfare isn't hit
By my small lawless dealings!"

Inflationary Mary's wrong.
For she'd be much to blame
If people in a mighty throng
Should say and do the same.

Small spendings, in the aggregate,
Reach sums extraordinary,
So let's not try to imitate
Inflationary Mary.

★ ★ ★

ADVERTISERS, PUBLISHERS—NOTE:

You are welcome to use all or any part of the material on this page to aid the fight against inflation.

SNAKE IN THE GAS

There was a crooked man and he
lived in crooked style,
He dealt at crooked markets with a
smugly crooked smile.
He viewed himself as clever with
his crooked ration book,
But everybody knew him for a
crooked little crook.

★ ★ ★

THE GANG'S ALL HERE

You may ask, "Why should *my* spending
Cause inflationary trending
Though I squander every penny I have got?"
—If you're joined by sixty millions
Of civilians blowing billions,
You'll discover that it matters quite a lot!

YOU CAN LAY TO THAT

As the best egg for a nest-egg
Buy a War Bond—buy a batch.
But you gotta keep 'em settin'
Or they ain'ta gonta hatch!

Save your pay
Here's a way—
Bonds and savings and insurance
Give your future more endurance.
Mrs., Mister,
Brother, Sister,
Don't compete in buying things
That is whence inflation springs.

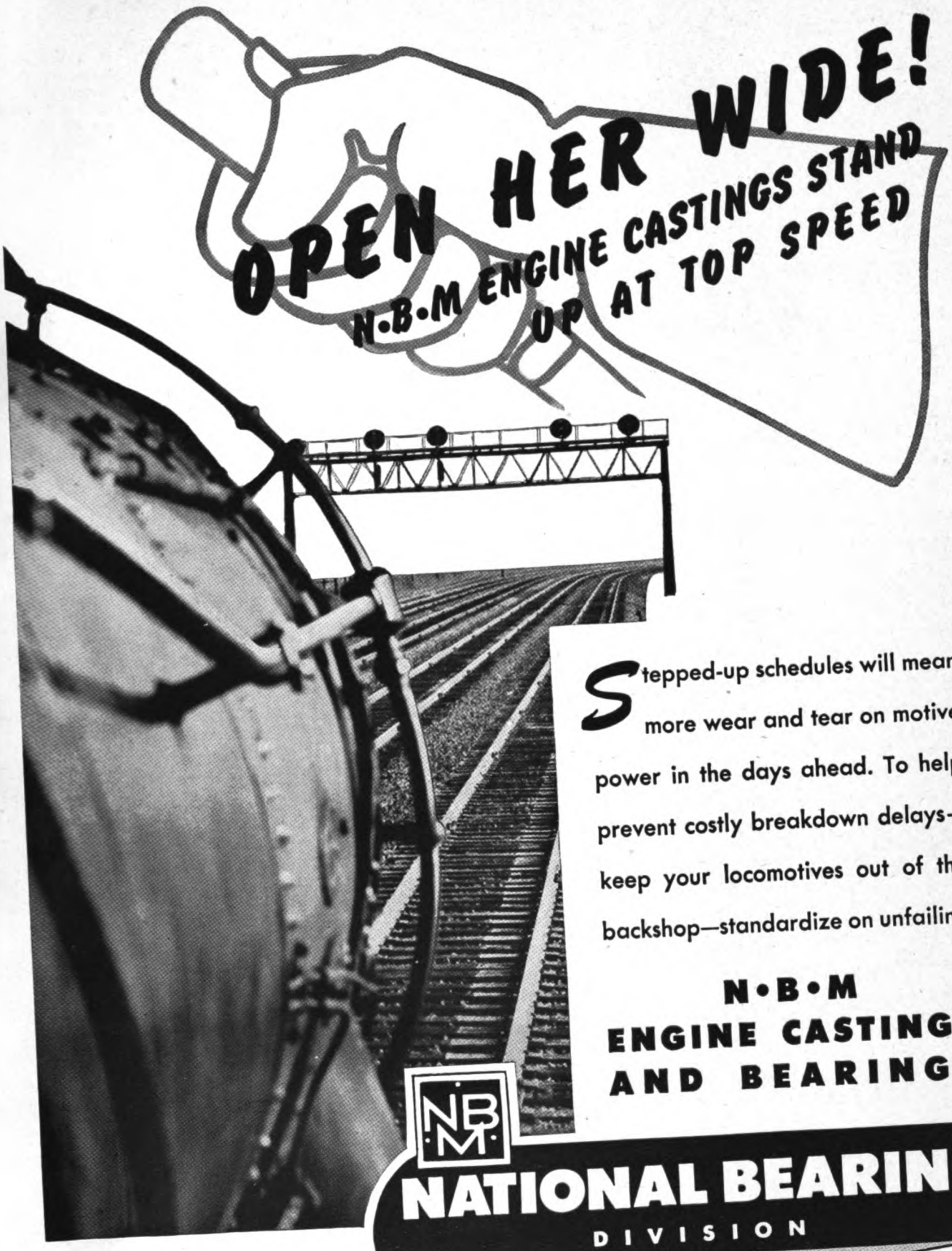
ONE PERSON CAN START IT!

You give inflation a boost

—when you buy anything you can do witho
—when you buy above ceiling or without
giving up stamps (Black Market!)
—when you ask more money for your servi
or the goods you sell.

SAVE YOUR MONEY. Buy and hold all t
War Bonds you can afford—to pay
the war and protect your own futu
Keep up your insurance.

A United States War message prepared by the War Advertising Council; approved by the Office of War Information; and contributed by this magazine in cooperation with the Magazine Publishers of Amer



Stepped-up schedules will mean more wear and tear on motive power in the days ahead. To help prevent costly breakdown delays—keep your locomotives out of the backshop—standardize on unfailing

N·B·M ENGINE CASTINGS AND BEARINGS

N·B·M

NATIONAL BEARING DIVISION

ST. LOUIS • NEW YORK

AMERICAN Brake Shoe COMPANY

PLANTS IN: ST. LOUIS, MO. • PITTSBURGH, PA. • MEADVILLE, PA. • JERSEY CITY, N. J. • PORTSMOUTH, VA. • ST. PAUL, MINN. • CHICAGO, IL

52,525 miles in two months

A TRIUMPH OF "ALCO Balanced Power!"

THIS huge mileage was rolled up on the difficult "Commodore Vanderbilt" run between Harmon and Chicago, during August and September. Average haul was 14 to 15 heavy Pullmans at 56.2 miles per hour over the 925 mile run.

ALCO BALANCED POWER, embodying boldly improved design features perfectly coordinated, jointly developed by American Locomotive and New York Central engineers, produced an unprecedented combination of speed, power and operating flexibility in this great steam locomotive.

Because of its great speed, power and extraordinary design flexibility, the "Niagara" can be operated without sacrifice of efficiency in either fast freight or passenger service.

In this new "Niagara", ALCO BALANCED POWER in steam locomotive design establishes for the railroad industry a new high level of steam motive power economy.

ALCO Balanced Power

Design Features in the "Niagara"

Salient features contributing basically to ALCO BALANCED POWER in the "Niagara" include:

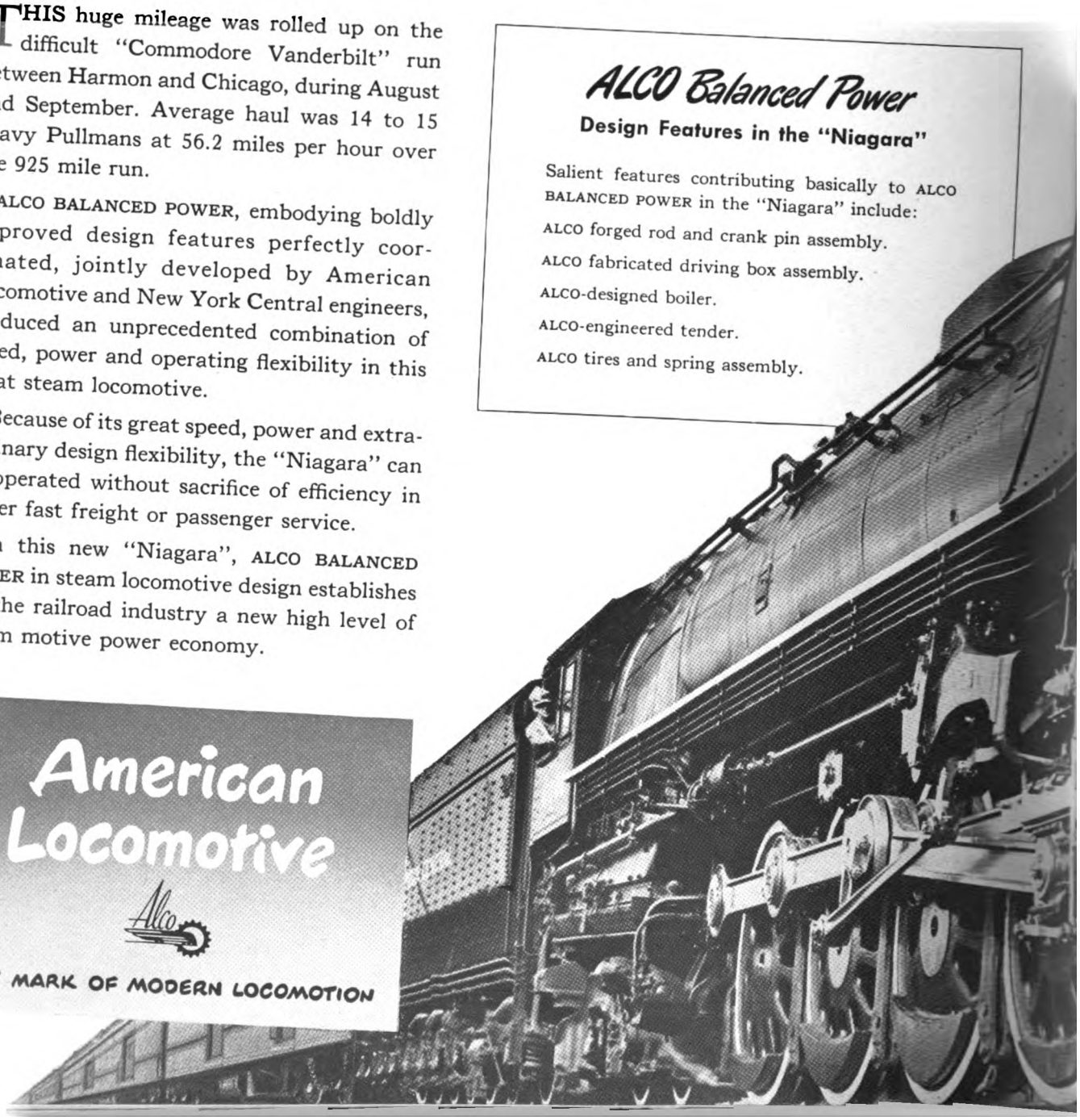
ALCO forged rod and crank pin assembly.

ALCO fabricated driving box assembly.

ALCO-designed boiler.

ALCO-engineered tender.

ALCO tires and spring assembly.



American Locomotive

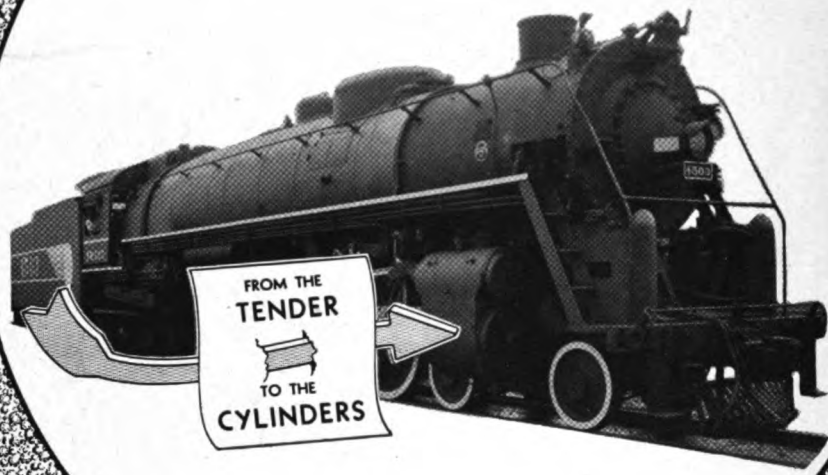
Alco

THE MARK OF MODERN LOCOMOTION

BY NEW YORK CENTRAL'S NEW "NIAGARA" LOCOMOTIVE

FEEDWATER HEATING
By Coffin

PROMOTES LOCOMOTIVE EFFICIENCY



OVER 100,000 MILES, 1 YEAR OF SERVICE, WITHOUT MAINTENANCE IS INDICATIVE OF COFFIN DESIGN AND DEPENDABILITY.

Send For Descriptive Bulletin

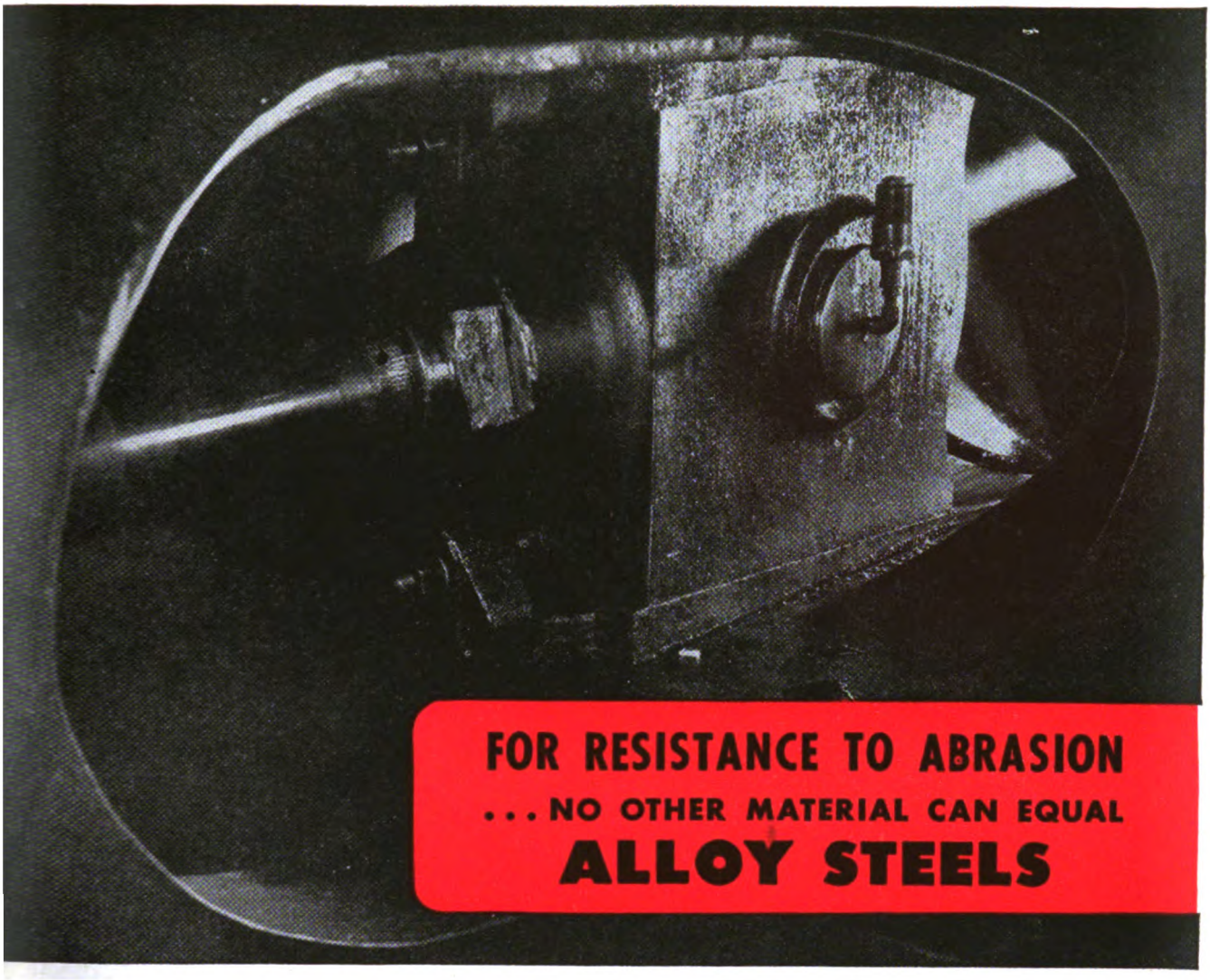
THE J. S. COFFIN, JR., COMPANY
ENGLEWOOD, NEW JERSEY

PLEASE SEND FEED WATER HEATER BULLETIN

NAME _____

COMPANY _____

ADDRESS _____



FOR RESISTANCE TO ABRASION
. . . NO OTHER MATERIAL CAN EQUAL
ALLOY STEELS

● When locomotive parts like that above, or any machine parts with bearing surfaces, slide back and forth, or turn 'round and 'round, there's bound to be abrasion. And abrasion means wear, unless the parts that slide and turn are hard enough to resist abrasion.

When it comes to hardenability, no other material can equal alloy steels. That's why so many vital operating parts in all kinds of equipment are made of these finest of steels.

Alloy steels can be surface hardened or deep hardened to predetermined degrees of hardness with greater assurance of results than any other material. Their uniform response to hardening insures against non-hardened areas or soft spots in wearing surfaces.

But that's only one advantage of using alloy steels. Their high strength-to-weight ratio permits the use with safety of lighter equipment and smaller sections. Their super-toughness provides protection against severe shocks, reversal of stresses or sudden overloading. Their resistance to fatigue, heat, cold and corrosion means long life and lower costs for equipment in which they are used.

Would you like to know what alloy steels can do for you? Republic—world's leader in this branch of steel making—is ready to tell you whenever you're ready to listen.

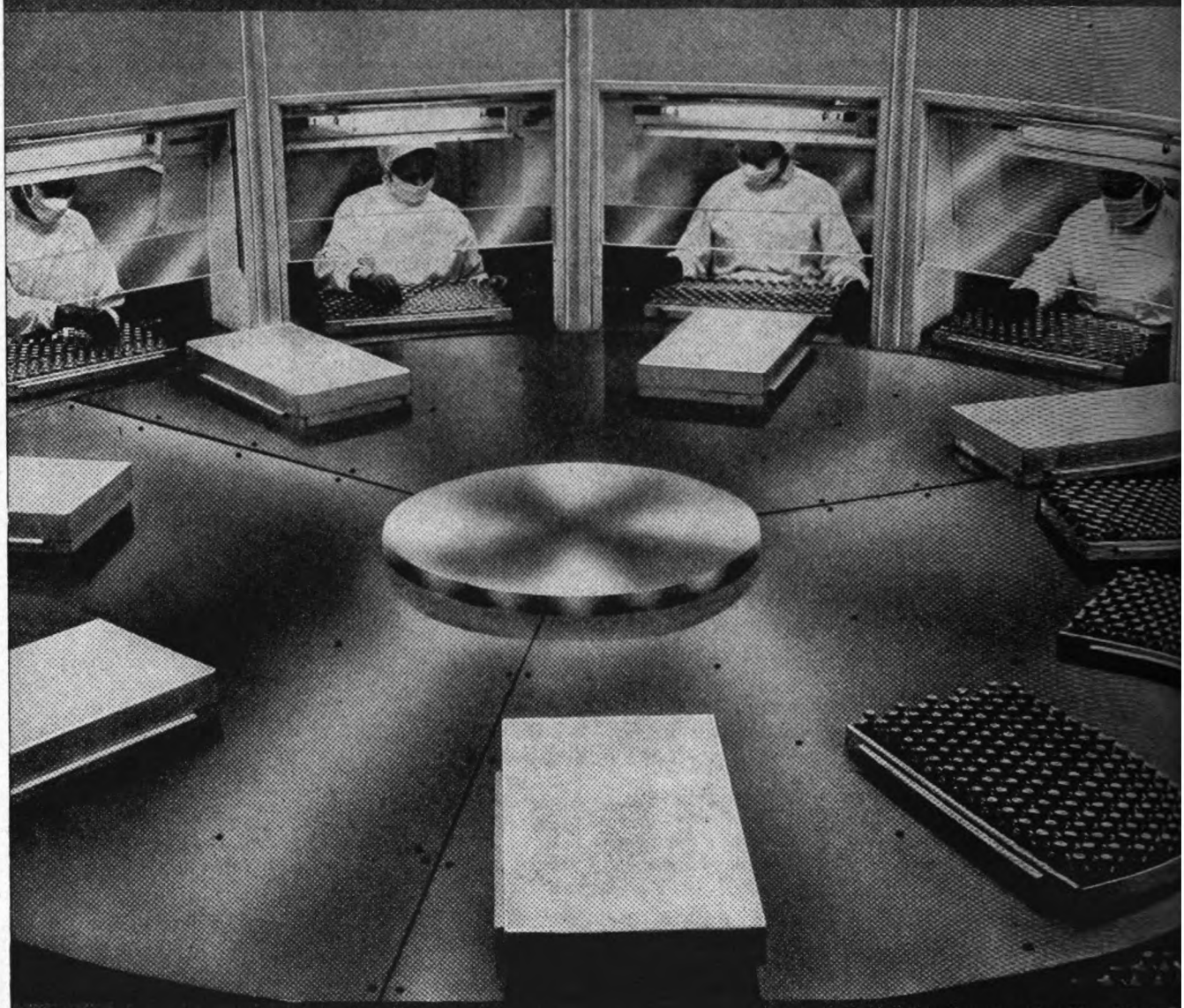
REPUBLIC STEEL CORPORATION
Alloy Steel Division • Massillon, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, N.Y.

Republic
ALLOY STEELS

...to Carbon and Stainless Steels—Sheets—Plates—Pipe—Upson Bolts, Nuts and Rivets—Electrunite Boiler Tubes

STAINLESS STEELS

Most versatile of modern metals...their unique combinations of properties merit your consideration in designing for the future.



"Photograph courtesy Chas. Pfizer & Co., Inc."

Packaging the miracle drug... penicillin...calls for completely sterile conditions. Here the table must be the very acme of aseptic cleanliness... easy to clean and keep clean. Hence, it's chromium-Nickel stainless steel.

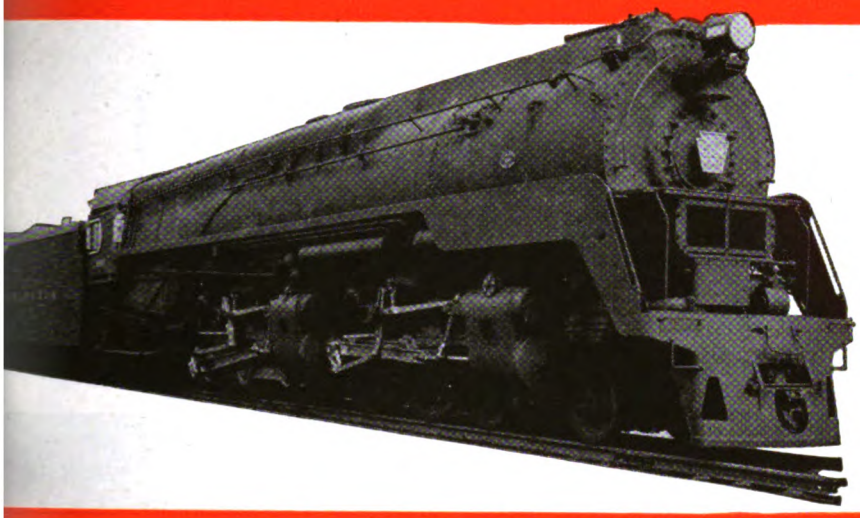
• • •

International Nickel are miners, smelters and refiners of Nickel, an important ingredient of the stainless steels, but do not produce stainless steels. If interested, please communicate with your established sources of supply for stainless steels.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 Wall Street New York 5, N.Y.

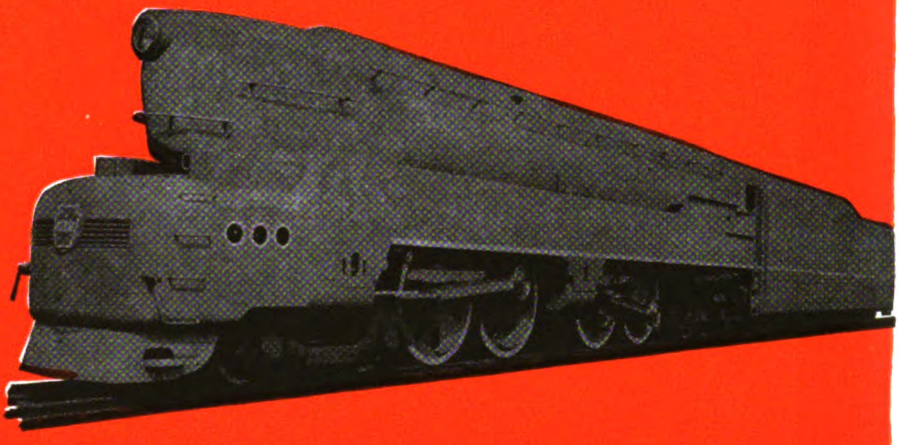
LATEST IN PENNSYLVANIA POWER

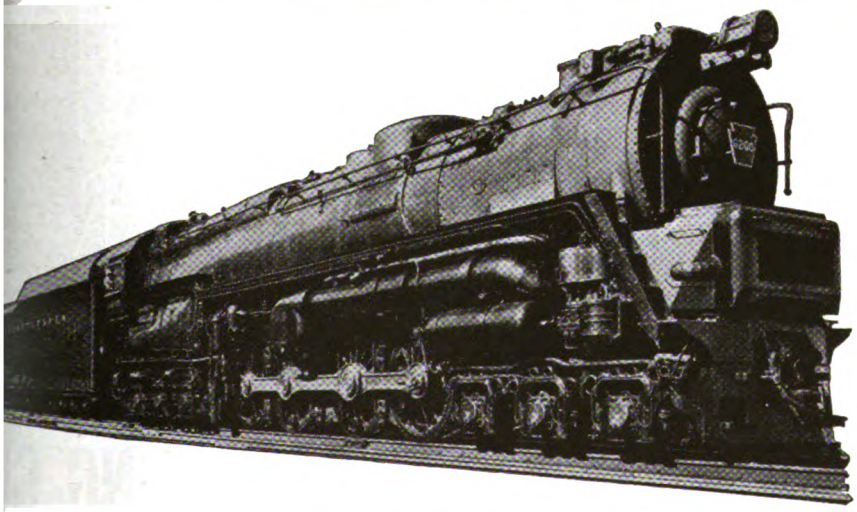
All TIMKEN ROLLER BEARING EQUIPPED



Class Q-2 Type 4-4-6-4 designed for hauling heavy freight trains at higher speeds. Equipped with Timken Bearings on engine trucks, driving axles, trailer trucks. 26 locomotives in service.

Class T-1 Type 4-4-4-4 for high-speed passenger and fast freight service. Engine trucks, driving axles, trailer trucks, all mounted on Timken Bearings. Also equipped with Timken driving rods, crank pin bearings, light weight reciprocating parts. Two locomotives in service and fifty under construction.





Class S-2 Type 6-8-6 direct drive steam turbine locomotive for high-speed passenger and fast freight service. All axles, including driving axles, and side rod crank pins mounted on Timken Bearings.

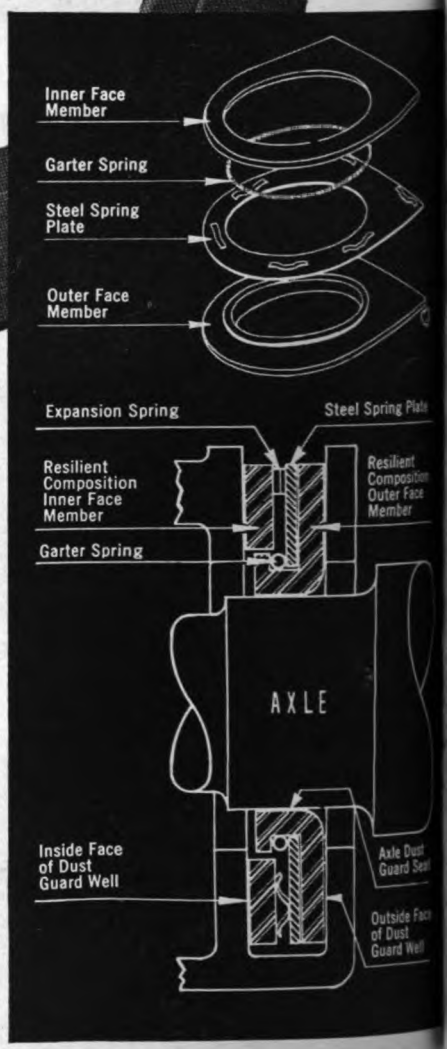
THE TIMKEN ROLLER BEARING COMPANY, CANTON 6, OHIO

NEW!

AMWELD

E-X-P-A-N-D-I-N-G

dust guards



Give 100% seal

AMWELD Expanding Dust Guards assure positive protection against dust, water and grime in journal boxes. The complete unit consists of only four pieces — two composition face members, metal plate with six spring steel springs and a garter spring. All metal is completely cased to avoid any possibility of wear on the axle. The springs hold the guard snugly against the inside and outside faces of the dust guard well — expand as required and provide a perfect seal at all times.

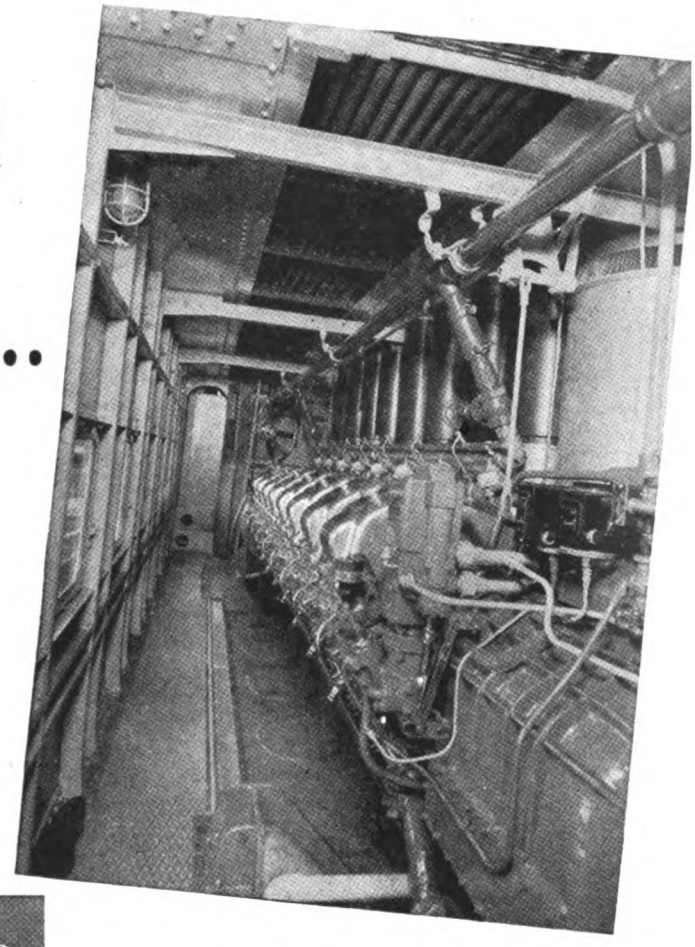
AMWELD Expanding Dust Guards are sturdily constructed — no loose parts and are applied without tools. They fit all standard AAR journal boxes without change. Their performance is not affected by oil, moisture, dust, ice or temperature. They protect journal packing, reduce lubrication troubles and costs, and minimize hot boxes because the boxes stay sealed. They increase the life of bearings, journals and packing. For more detailed information write.

RAILWAY EQUIPMENT DIVISION

THE AMERICAN WELDING AND MANUFACTURING CO

WARREN, OHIO

Tough enough for break-ins... gives long, clean service



NONPAREIL HD
DIESEL OIL

ENGINE BUILDERS and many operators use Nonpareil HD Diesel Oil as a break-in oil. They find it provides smoother break-ins with no scratching or scuffing of pistons in cylinders. The detergent quality in Nonpareil HD helps remove the finely divided metal particles resulting from wear in the break-in period. The oxidation inhibitor prevents excessive heat, usually accompanying a break-in, from oxidizing the oil to form varnish and other deposits.

These same excellent qualities provide unusual freedom from wear and deposits in continuous operation under heavy-duty service.

The next time you break in an engine use Nonpareil HD—get off to a good start. Then continue to use Nonpareil HD and see how it lowers cleaning and maintenance costs.

Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Ill.

Buy and hold more Victory Bonds

TANDARD OIL COMPANY (INDIANA) STANDAR SERVIC

WOVENSTONE

THE PROVE

Operating tests prove that **INSUTAPE** eliminates 64% of bare pipe heat losses. Savings have been proved under still air conditions, but are much greater under wind velocity conditions found in the actual operation of rolling stock.

WOVENSTONE has proved its efficiency in 12 years of *"active service."* Many mechanical men can point with pride to rolling stock that is still equipped with its original Wovenstone—rolling stock placed in service over 12 years ago!

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

310 S. MICHIGAN AVENUE

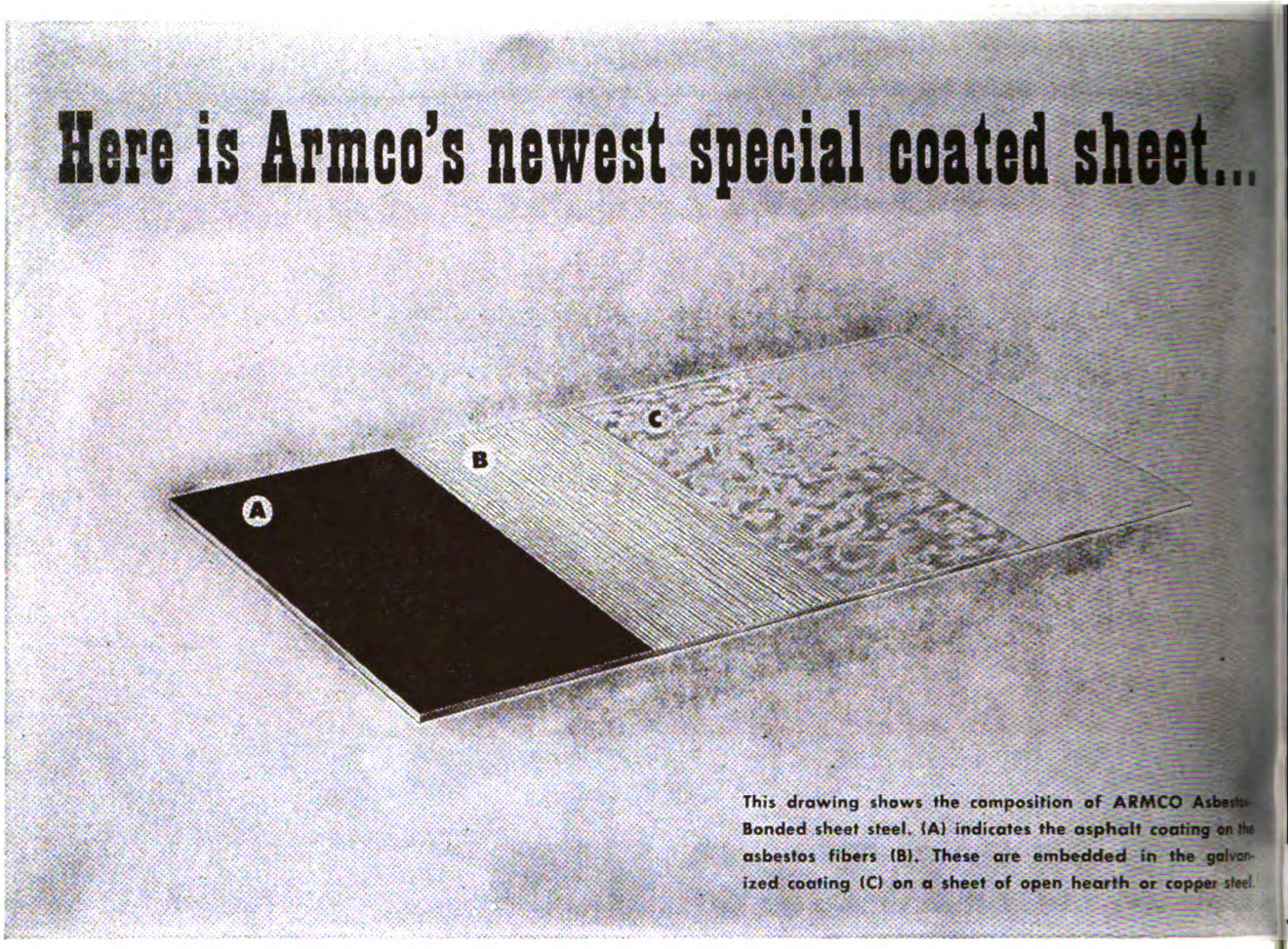
INSUTAPE and WOVENSTONE save fuel and eliminate maintenance problems. Their high insulating efficiency means greater passenger comfort, too. Unarco steam-pipe insulations prevent pipes from freezing—keep steam coursing through the train at peak-efficiency; will not shake down—always remain snug and firm against the pipe—can be reapplied over and over again.

INSULATIONS

UNION ASBESTOS
MEANS PROGRESS IN INSULATION
AND RUBBER CO.

CHICAGO 4, ILLINOIS

Here is Armco's newest special coated sheet...



This drawing shows the composition of ARMCO Asbestos-Bonded sheet steel. (A) indicates the asphalt coating on the asbestos fibers (B). These are embedded in the galvanized coating (C) on a sheet of open hearth or copper steel.

Asbestos-Bonded Steel for railway uses

The newest specialty sheet steel for car parts and other railway uses is "ARMCO Asbestos-Bonded Steel."

It is the sheet steel counterpart of ARMCO Asbestos-Bonded Steel Pipe—used successfully for many years in better-grade railroad drainage structures. Now this special corrosion-resistant coated steel is available in sheet form in 16 gage and heavier.

ARMCO Asbestos-Bonded Steel has a coating of zinc with a layer of asbestos felt that is firmly pressed into the zinc while it is still molten. The asbestos felt layer is then saturated with hot asphalt. The surface is relatively smooth and uniform and is off-black in color.

MANY RAILWAY USES

Because it has exceptional resistance to acids, alkalies and water, ARMCO Asbestos-Bonded Steel is ideal for many railway uses. These include interior parts of refrigerator cars and refrigerated express cars, passenger car flooring, various freight car roofing parts, smoke jacks and blast plates.

It is also excellent for other "hidden" sheet steel parts that cannot be painted regularly—especially parts that are exposed to steam or condensation.

STANDS UP IN TESTS

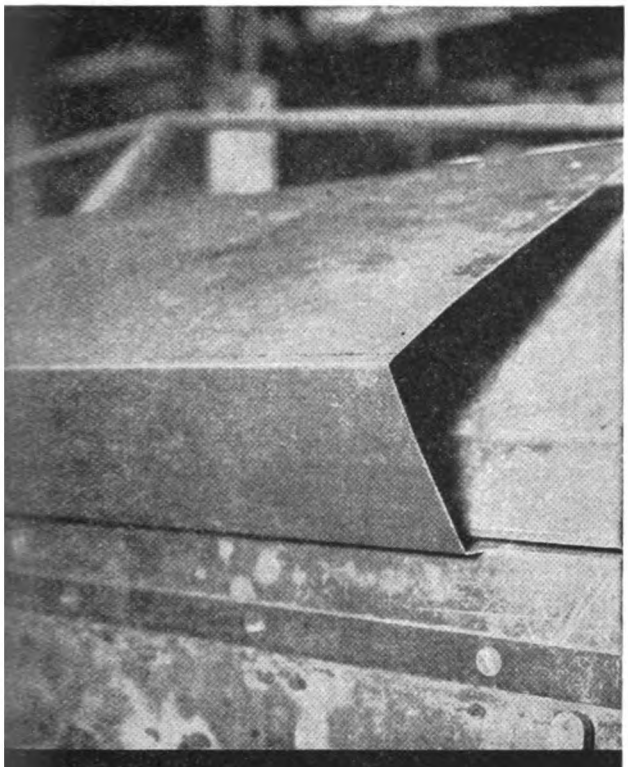
Various laboratory tests in aqueous salt baths, salt spray, acids, and underwater show that the ARMCO *Asbestos-Bonded coating gives complete protection to the galvanized coating underneath.* In the same tests ordinary galvanized coatings failed completely.

The Asbestos-Bonded coating thickness on each side is from .008 to .010 inch. This is in addition to the thickness of the zinc coating.

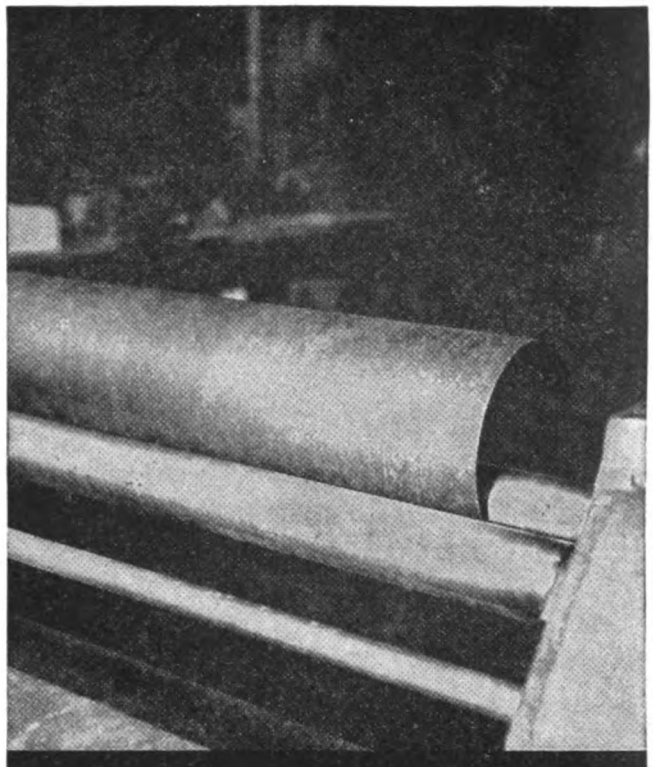
FORMS, WELDS READILY

Under proper conditions ARMCO Asbestos-Bonded Steel can be rolled and formed in a brake without damage to the coating. It can be bent to an angle of 180° over a diameter of 4 times the thickness of the sheet. For severe forming, the temperature of the steel should be between 90° and 110°F.—never under 70°.

This sheet steel can be arc or acetylene-welded.



Right-angle bends are no problem for ARMCO Asbestos-Bonded Steel when proper radius and clearance are used.



When temperature conditions are normal, rolling does not damage the asbestos-bonded coating.

WEIGHT DATA

Gage numbers in the following table apply to the galvanized steel without the asbestos-bonded coating. The table gives the weight comparison per square foot for various gages, after coating:

Gage	*Galvanized* *Wt. Per Sq. Ft.*	*Asbestos-Bonded* *Wt. Per Sq. Ft.*
16	2.656 lbs.	2.821 lbs.
14	3.281 lbs.	3.446 lbs.
12	4.531 lbs.	4.696 lbs.
10	5.781 lbs.	5.946 lbs.
8	7.031 lbs.	7.196 lbs.

OTHER SPECIAL-PURPOSE ARMCO SHEET STEELS

HIGH STRENGTH STEELS

Save weight, boost pay loads

STAINLESS STEELS

Save weight, reduce maintenance

PAINTGRIP

Takes paint readily—holds it

ZINCGRIP

Zinc coating won't peel in drawing operations

WRITE FOR DETAILS

You are invited to test ARMCO Asbestos-Bonded Sheets in your own equipment—wherever a corrosion-resistant steel is needed. Our metallurgists will be glad to work with you. Just address The American Rolling Mill Company, 3021 Curtis Street, Middletown, Ohio.

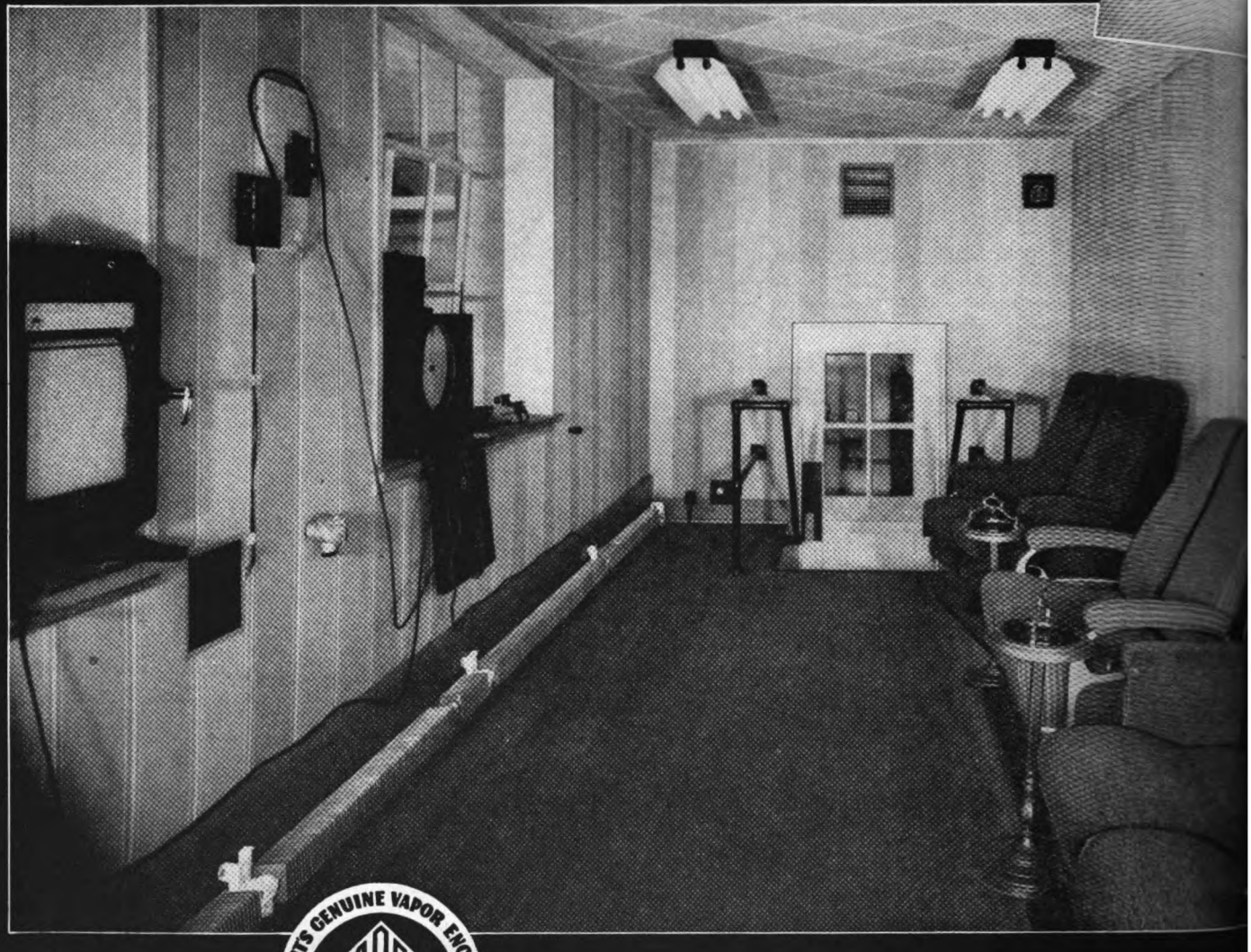
ARMCO

SPECIAL-PURPOSE SHEET STEELS

THE AMERICAN ROLLING MILL COMPANY

FOR THE FIRST TIME IN THE HISTORY OF RAILROADING

TEMPERATURE COMFORT IN A PASSENGER CAR IS ACCOMPLISHED BY A STEADY EVEN FLOW OF EXACTLY THE RIGHT AMOUNT OF HEAT FROM THE RADIATION THROUGH THE USE OF THE NEWLY PERFECTED VAPOR CYCLE MODULATION CONTROL



BE SURE ITS GENUINE VAPOR ENGINEERED
VAPOR SYSTEM
GUARANTEED EFFICIENCY

VAPOR CAR

YOU ARE INVITED TO VISIT A DEMONSTRATION OF NEW DEVELOPMENTS IN CAR HEATING AT YOUR CONVENIENCE

[VAPOR "CYCLE MODULATION"]

PROVIDES TEMPERATURE COMFORT IN EVERY PORTION OF THE CAR BY PROPER ZONING OF THE PIPING WITH CYCLE MODULATION CONTROL

Cycle modulation, obtained through the Vapor anticipating action mercury tube thermostats, is the most effective control for car temperatures. Its development followed the development of air conditioning itself, with improvements and simplifications in circuits being discovered and adopted.

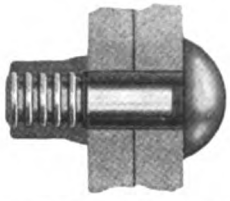
AND NOW, Vapor Cycle Modulation Control actually operates to control the temperatures of the radiation piping so that it delivers a constant steady source of heat in direct proportion to the car's requirements without overheating or underheating at any time.

HEATING CO., INC., RAILWAY EXCHANGE CHICAGO 4, ILLINOIS

FOR FASTER, PERMANENT ASSEMBLY

It's the Huck LOCKBOLT

COLLAR PIN



SECTION THROUGH
DRIVEN HUCK LOCKBOLT

A COMPLETELY *New* TYPE OF FASTENER OFFERING MANY UNIQUE ADVANTAGES

Neither a bolt nor a rivet, the Huck Lockbolt combines the advantages of ***both*** of these fastening devices and offers definite advantages over each. It's more quickly installed than a bolt—pulls the work tightly together before locking—fills the hole completely when required for maximum strength and rigidity—and fastens ***permanently*** without the use of lockwashers, cotterpins or special nuts. Tensile strength is comparable to that of bolts, shear strength equals or exceeds that of conventional rivets, and liberal hole size tolerance is allowed.

HOW IT'S APPLIED The pin is inserted from the back side of the work, the collar is slipped onto the pin, and the driving gun is applied to the pull grooves in the projecting end of the pin. Then, in rapid succession, the gun squeezes the work together between the collar and the head of the pin, wire-draws the pin to a press fit in the hole when hole filling is required, swages the collar into locking grooves in the pin, breaks the pin off flush with the collar, and frees itself from the swaged collar.

Thus the Lockbolt, after accomplishing a bolting-up operation, becomes the equivalent of a rivet, forming a rigid and permanent fastening. Either a hand-operated or a pneumatic gun can be used, as illustrated.

Small hand gun is ideal for mai tenance jobs. Six to 10 Lockbolts p minute can be driven with this to

MATERIALS AND SIZES AVAILABLE Huck Lockbolts are available in two types—(1) for applications requiring hole filling (to replace rivets and close-fitting bolts), and (2) to replace bolts in clearance holes. They are furnished with heads of any type desired, and with pins of 24ST aluminum alloy, carbon steel, or high-strength alloy steel. Lockbolts are now available in 3/16" diameter with grip lengths ranging from 1/32" to 21/32" by 16ths. Lockbolts of 1/4" and 5/16" diameter will soon be available.

This DIFFERENT type of fastener may save both time and money on YOUR assembly jobs, whether special or every-day—production or maintenance. Investigate its possibilities! Further information on request.

The fast, light-weight pneumatic g will drive from 20 to 40 Lockb per minute and is recommended f production work.

For applications where the back side of the work is ***inaccessible***, HUCK BLIND RIVETS may be the answer. Bulletin 451 gives full details; may we send you a copy?

Huck MANUFACTURING CO.

2480 BELLEVUE AVENUE DETROIT 7, MICHIGAN

ROL-MAN

Self-Renewing Armor Against Abrasive Wear

Rol-Man surfaces cold work-harden with abrasion and impacts; they develop hard, smooth, shiny armors against wear, yet underneath, the metal retains its original toughness to absorb shocks and resist breakage.

As a millionth of an inch of hard surface slowly wears, another millionth of hardness builds up underneath, thus the thickness of the work-hardened section maintains itself despite wear.

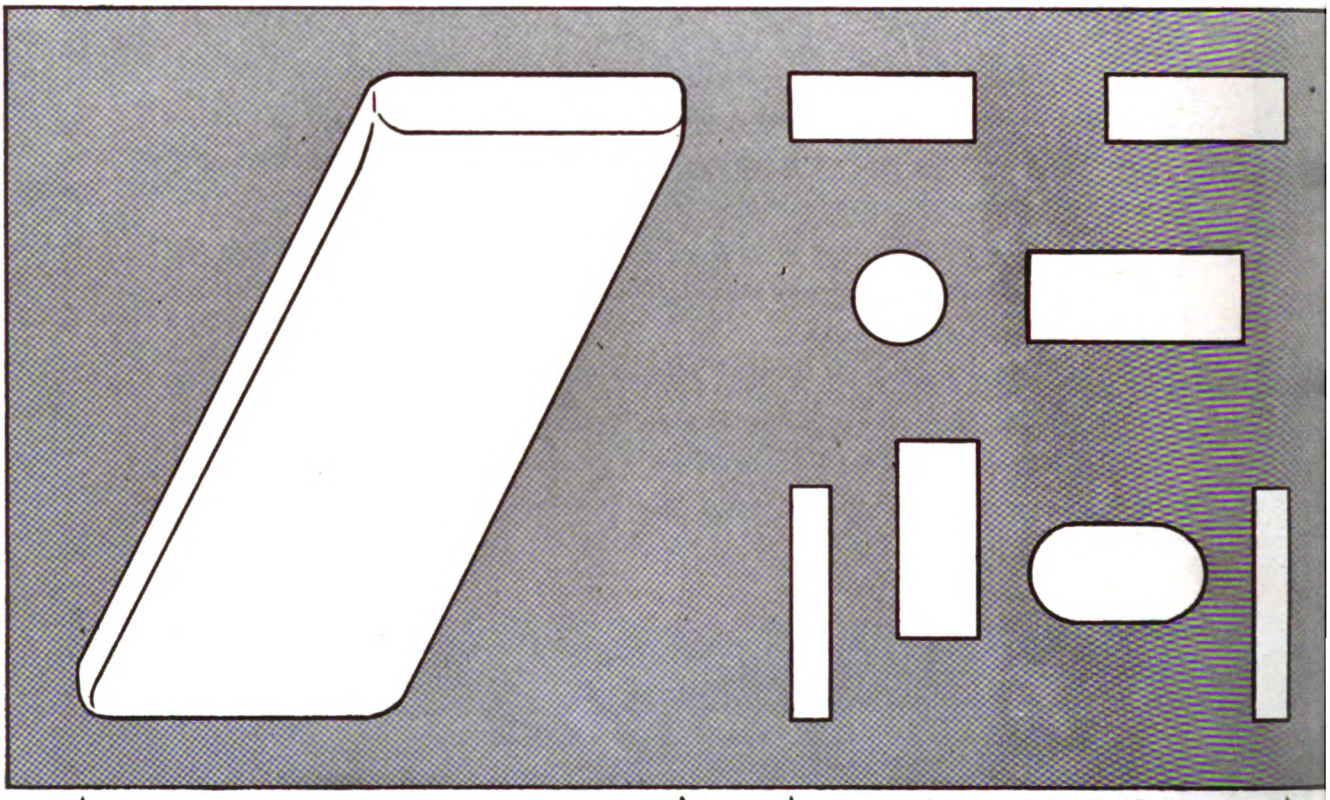
Use Rol-Man High (11% to 14%) Manganese Steel for Passenger Car Truck Swing Hanger Connections, Center Bearing Wear Plates, Pedestal and Box Liners, and all other parts that demand the utmost in abrasion resistance and strength . . . Manganese Steel Forge Co., 2813 Castor Avenue, Philadelphia 34, Pa.

Rol-Man Pins and Bushings are ground to precision diameters. Wear Plates are fabricated to your specifications ready for installation.

PINS • BUSHINGS • WEAR PLATES

Conditioned Lighting

ONE LARGE, GENEROUS SOURCE OF LIGHT.
A SOFT PLEASING GLOW.
AN ABUNDANCE OF LUMENS.
UNOBTRUSIVE BECAUSE IT IS LARGE.
REPLACES MANY SMALL LIGHTING FIXTURES.



FOR TIRELESS READING—Ample diffused illumination where you want it.

WHEN IN FRONT OF A MIRROR—Illumination on your face —not a glare in your eyes—for facial make-up or shaving.

IF MORE LIGHT IS DESIRED, JUST ADD MORE LAMPS TO THIS UNIT INSTEAD OF BUYING MORE FIXTURES, MORE METAL, MORE WEIGHT, MORE WIRING AND MORE COSTLY MAINTENANCE.

YOU CAN NOW GET THESE LARGE FIXTURES BECAUSE—

They require large, light weight transmitting shades now available in "Safety 68" Plexiglas.
They require long lamps now available in fluorescent.
They must have quick easy access to lamps—
a Safety Company feature.

THE SAFETY CAR HEATING AND LIGHTING COMPANY, INC.

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Is your name here?

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Erie Railroad
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Wabash
Illinois Central
Gulf Mobile & Ohio
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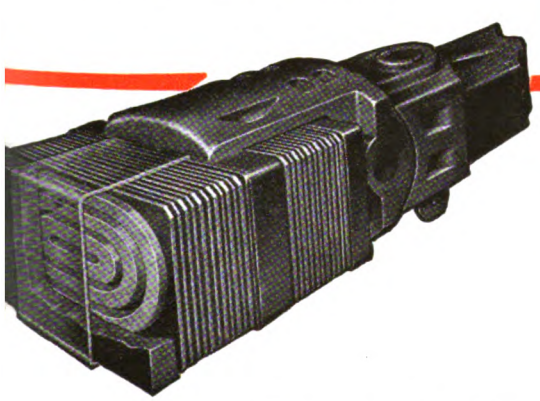
25

PROGRESSIVE AMERICAN RAILROADS

are equipping their newest and finest passenger cars with...



WAUGHMAT *Twin Cushions*

WAUGH EQUIPMENT COMPANY, NEW YORK

Chicago • St. Louis • Canadian Waugh Equipment Company: Montreal

TROUBLES SUBSIDE

It was a slow and troublesome job to drive small slotted screws in fastening a pressed fabric panel on this electrical relay for the P-80 Jet Plane. Frequent driver skids gouged the special fungus-resistant varnish, forced disassembly and junking of marred panels.

OUTPUT HITS STRIDE

Assembly of this part was speeded up 400% when a change was made to Phillips Recessed Head Screws. Fumbling was ended, and a spiral driver could be used, permitting faster driving. Driver skids were eliminated, along with waste of parts and time for disassembly and reassembly.

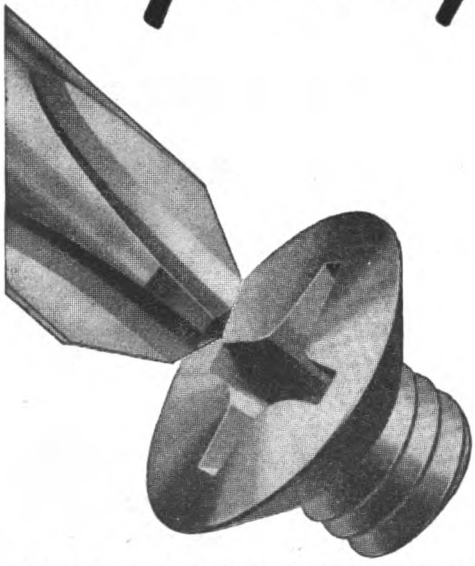
NEW STRENGTH SUPPLIED

Design engineers favor Phillips Screws, because they not only speed output and reduce costs . . . they also permit design improvements that add strength, often with the use of fewer screws. This advantage is especially evident in compact, complicated assemblies.

SHOW IT WITH PRIDE

Wherever screw heads are exposed, the Phillips Recess adds a sales advantage. No unsightly burrs to snag clothing or nick fingers – and sidetrack sales! Its ornamental design blends with modern contours – and it needs only a quarter turn to line up – looks well in any position.

It's Phillips ... the engineered recess!



In the Phillips Recess, mechanical principles are so correctly applied that every angle, plane, and dimension contributes fully to screw-driving efficiency.

. . . It's the exact pitch of the angles that eliminates driver skids.

. . . It's the engineered design of the 16 planes that makes it easy to apply full turning power – without reaming.

. . . It's the "just-right" depth of recess that enables Phillips Screw Heads to take heaviest driving pressures.

With such precise engineering, is it any wonder that Phillips Screws speed driving as much as 50% – cut costs correspondingly?

To give workers a chance to do their best, give them faster, easier-driving Phillips Recessed Head Screws. Plan Phillips Screws into your product now.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

Made in all sizes, types and head styles

25 SOURCES

American Screw Co., Providence, R. I.
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The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
General Screw Mfg. Co., Chicago, Ill.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
Manufacturers Screw Products, Chicago, Ill.
Milford Rivet and Machine Co., Milford, Conn.
The National Screw & Mfg. Co., Cleveland, Ohio
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Pawtucket Screw Co., Pawtucket, R. I.
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The Steel Company of Canada Ltd., Hamilton, Canada
Wolverine Bolt Co., Detroit, Mich.

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In addition to industrial hose, Weatherhead plants make all types of fittings, valves, hydraulic cylinders and other parts for these industries:

AUTOMOTIVE
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New uses are being found daily for the application of our *improved* industrial hose lines on machinery of all kinds. We manufacture hose assemblies of all types to withstand pressures up to 10,000 P.S.I. They can be equipped with either permanent crimped ends or with re-usable, quick-attachable hose ends. For information or literature write or phone any Weatherhead branch office.

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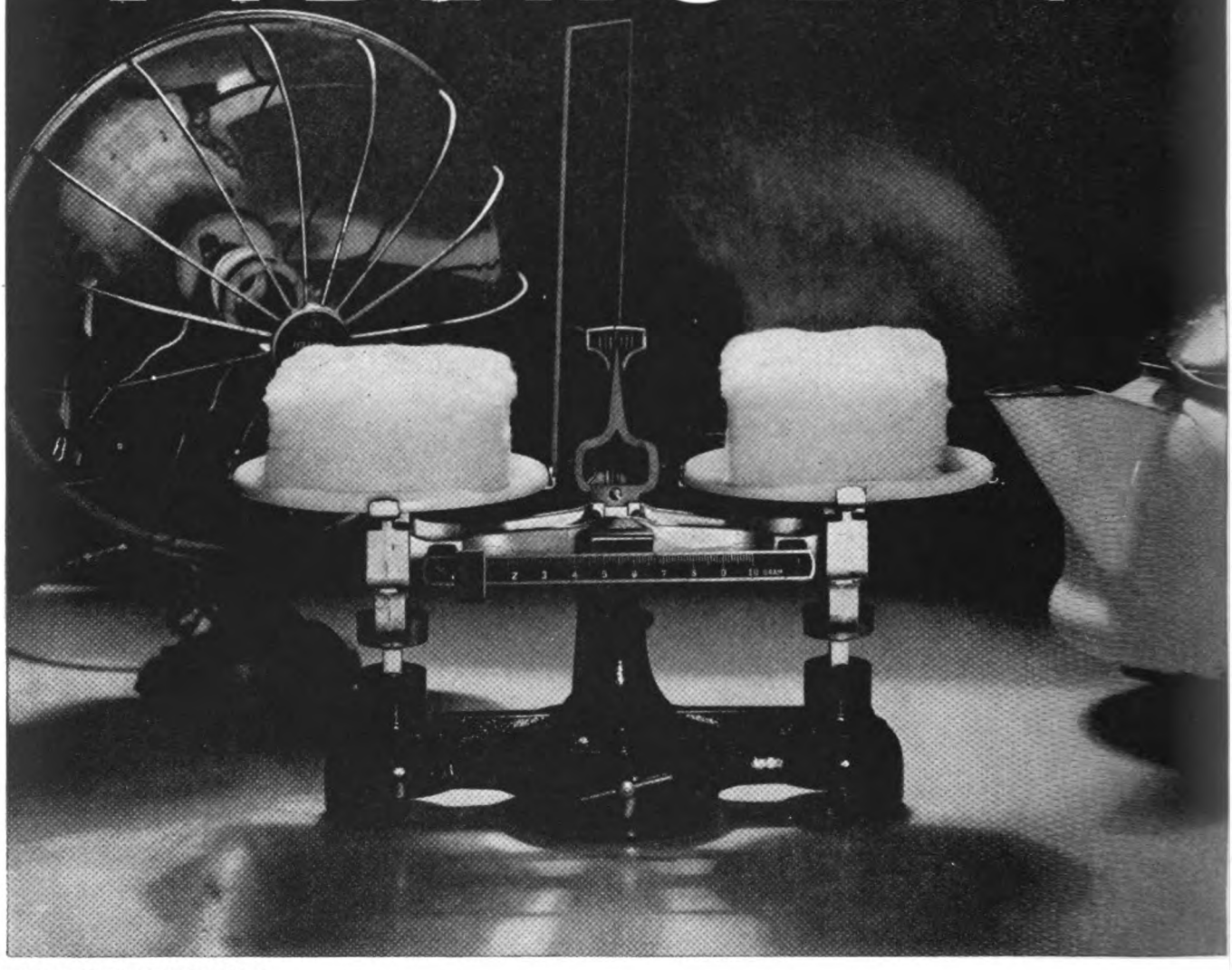
FIBERGLAS*



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For Making All Kinds of Parts

...Better...Faster...Cheaper

FINDING the right kind of tubing—Seamless or Welded—for any mechanical requirement is greatly simplified when the problem is put up to Babcock & Wilcox. Matching tubes to jobs—finding the steel analyses best suited for making load bearing and structural parts—is a specialty with B&W.

To this end, metallurgists and technicians are continuously searching for better alloys—testing for proper hardness and hardenability—checking yield strengths, elongation, and tensile strengths against service demands. At B&W your problems are considered in the light of experience with an unusually large variety of analyses, many of them available from no other source; first-hand knowledge of the fabricating, machining, heat-treating, and other capabilities of steels from simple low carbons to high alloys. Making a complete range of both Seamless and Welded Tubing, B&W is in a position to match tubes to jobs without prejudice toward any type or materials. B&W applications are therefore impartial and unbiased.

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THE BABCOCK & WILCOX CO.
85 LIBERTY STREET, NEW YORK 6, N.Y.

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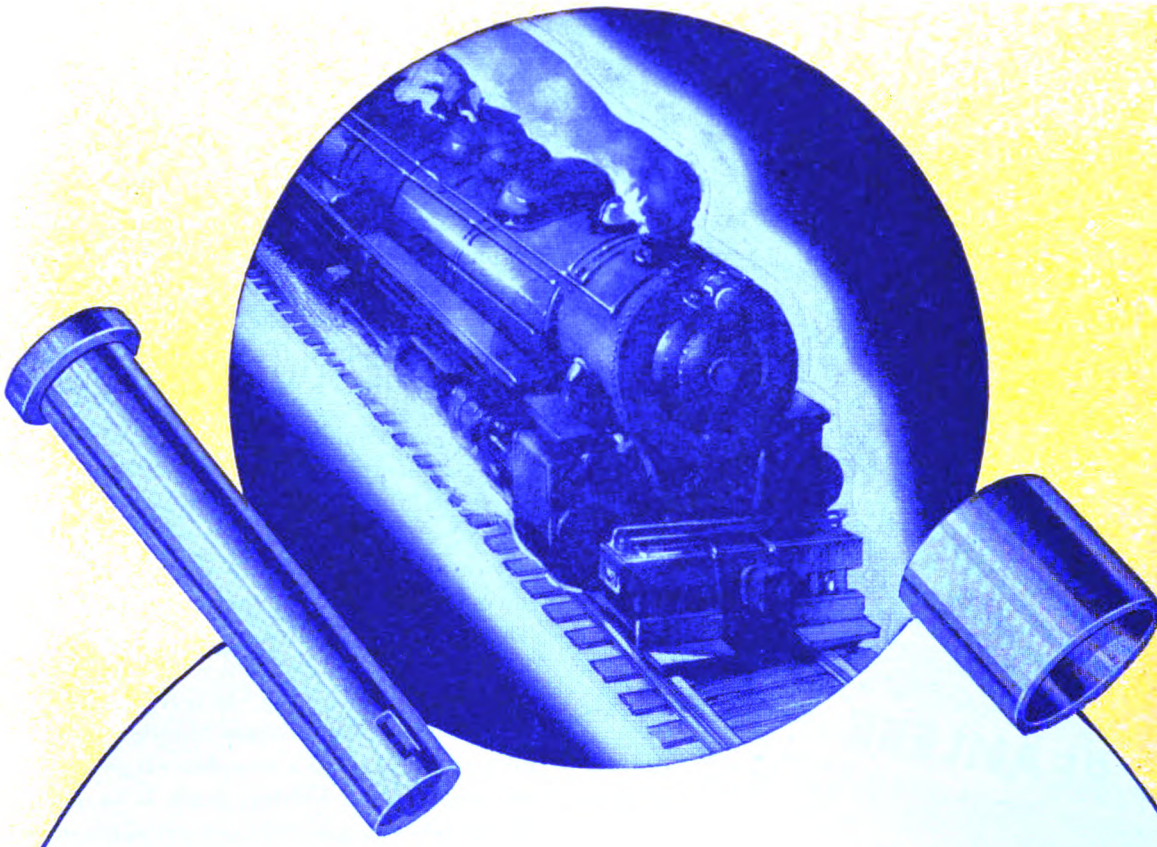
"better talk with API"

when it's PINS and BUSHINGS!



The low first cost you look for, and the long wear-life you demand, are BOTH answered in railroad pins and bushings from API. We have the skill and experience that counts . . . plus the right equipment for long, fast production runs. For maintenance replacement or original installation, talk with men who know your problems—and have *the right answers!* An API representative is ready to act fast—now—in your behalf.

AERONAUTICAL PRODUCTS, Inc.

Plant and General Offices: Washington Court House, Ohio.

NEW

The new Monroe Direct-Double-Action *Hydraulic* Shock Absorber especially designed for freight car trucks embodies the same exclusive principles first to be accepted for smoothing the ride on America's high speed crack streamliners. By controlling destructive vibration the new Patented Monroe Direct-Double-Action *Hydraulic* Shock Absorber for freight car trucks cuts vertical and swaying action . . . protects lading . . . prolongs equipment life and reduces roadbed wear. Maintenance costs and damage claims are reduced and cars are kept at work longer. Our Engineers will gladly work with you in the application of this modern new Monroe equipment. Just write, wire or phone our nearest branch office.

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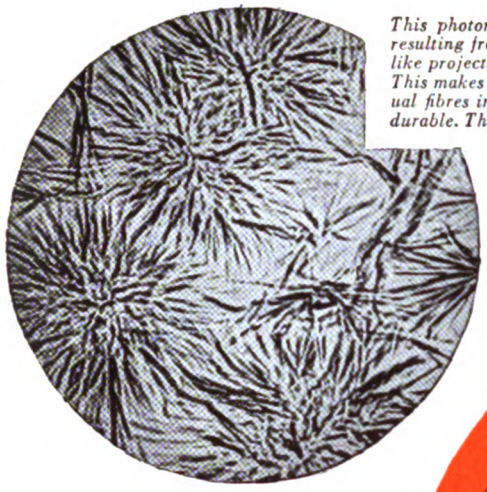
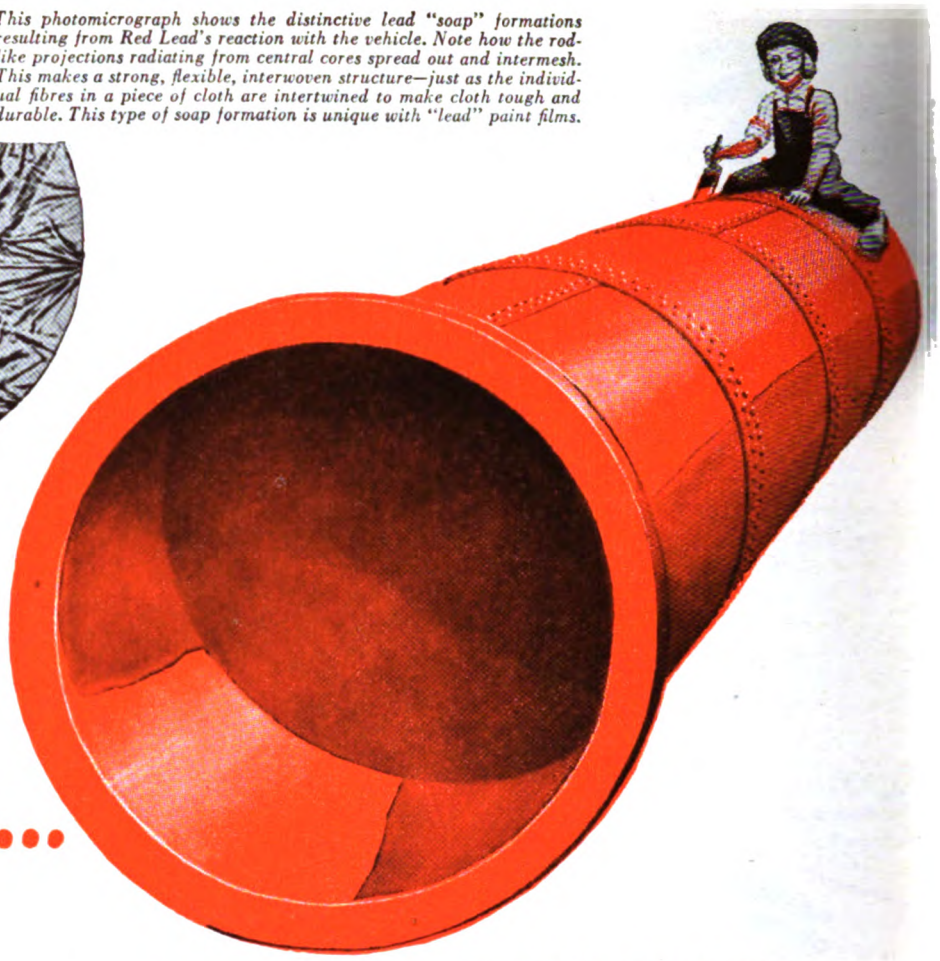


This photomicrograph shows the distinctive lead "soap" formations resulting from Red Lead's reaction with the vehicle. Note how the rod-like projections radiating from central cores spread out and intermesh. This makes a strong, flexible, interwoven structure—just as the individual fibres in a piece of cloth are intertwined to make cloth tough and durable. This type of soap formation is unique with "lead" paint films.



unique LEAD SOAPS...

another important reason why RED LEAD means Extra Rust Protection

Why is Red Lead outstanding as a metal protector?

One of the major reasons is this pigment's remarkable ability to impart to the paint film strong, tough, intertwining lead "soap" formations—as shown in the photomicrograph above.

These unique lead "soaps" improve the paint film in many ways. For one thing, they form a dense, intermeshing matrix which restricts the passage of water through the film. And rusting does not take place without the presence of moisture.

For another, they *mechanically* reinforce the film, giving it extra *strength* and *toughness*.

And again, Red Lead "soaps" contribute all-important *elasticity* — allowing movement along their intermeshing projections. This action helps prevent the ruptures to which a hard, unyielding film is subject. Moreover, when a paint film dries and ages, decomposition of the vehicle sets in. But, because of Red Lead's ability to combine with the decomposition products and form soaps, it increases both the durability of the paint film and its adhesion to the base metal.

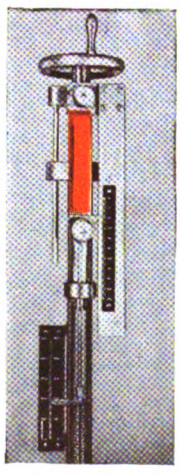
Red Lead's extra strength, toughness and elasticity are demonstrated by the tensile strength test below and substantiated by exhaustive research and field service.

Remember, too, that Red Lead is compatible with practically all vehicles commonly used in metal protective paints, including phenolic and alkyd resin types.

Specify RED LEAD for All Metal Protective Paints

The value of Red Lead as a rust preventive is most fully realized in a paint where it is the only pigment used. However, its rust-resistant properties are so pronounced that it also improves any multiple pigment paint.

* * *



In this tensile strength tester a typical Red Lead paint film has been stretched 18% without breaking. In withstanding this elongation it has maintained a load of 920 grams. Any film that exhibits these characteristics has unusual strength, toughness and elasticity. As metals expand and contract only a fraction of one percent, this film would adhere under the most extreme conditions.

No matter what price you pay, you'll get a better paint for surface protection of metal, if it contains Red Lead.

Write for New Booklet—"Red Lead in Corrosion Resistant Paints" is an up-to-date, authoritative guide for those responsible for specifying and formulating paint for structural iron and steel. It describes in detail the scientific reasons why Red Lead gives superior protection. It also includes typical specification formulas—ranging from Red Lead-Linseed Oil paints to Red Lead-Mixed Pigment-Varnish types. If you haven't received your copy, address nearest branch listed below.

* * *

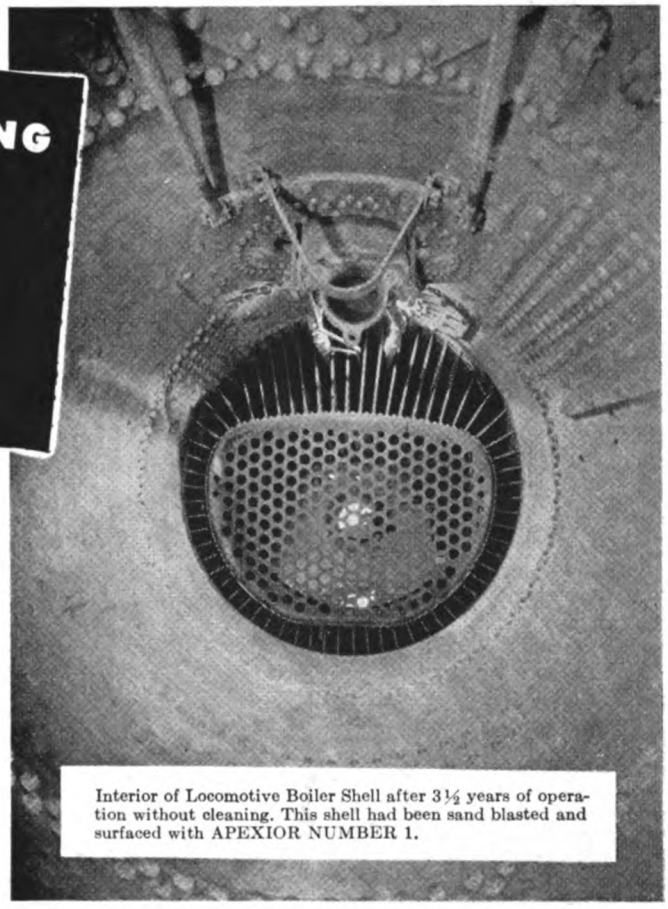
All types of metal protective paints are constantly being tested at National Lead's many proving grounds. The benefit of our extensive experience with Red Lead paints for both underwater and atmospheric use is available through our technical staff.

NATIONAL LEAD COMPANY: New York 6, Buffalo 3, Chicago 80, Cincinnati 3, Cleveland 13, St. Louis 1, San Francisco 10, Boston 6 (National-Boston Lead Co.); Pittsburgh 30 (National Lead & Oil Co. of Penna); Philadelphia 7 (John T. Lewis & Bros. Co.); Charleston, W. Va. (Evans Lead Division).

DUTCH BOY RED LEAD

HOW APEXIOR SURFACING CUTS LOCOMOTIVE SHOP TIME

Easier Cleaning . . . More Effective Washing . . . Longer Service from Boiler Metal



Interior of Locomotive Boiler Shell after 3½ years of operation without cleaning. This shell had been sand blasted and surfaced with APEXIOR NUMBER 1.

A protective coating of APEXIOR NUMBER 1, a few thousandths of an inch thick, over the water side of locomotive boiler shells and other surfaces exposed to boiler water and steam makes a big saving at shopping time.

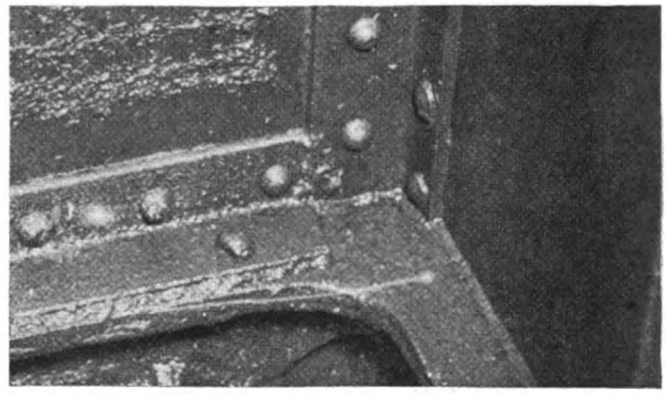
APEXIOR retards formation of scale and prevents any chemical bonding with the metal. What scale does adhere comes away easily. Furthermore, an APEXIORIZED surface remains smooth; boiler deposits have little to cling to, and flush away easily.

By preventing water-or-steam contact with metal, APEXIOR NUMBER 1 effectively retards or checks corrosion and pitting in locomotive boilers. Coating water contact areas subject to embrittlement or accelerated stress corrosion has proved effective in minimizing these hazards. **The APEXIOR NUMBER 1 coating needs no attention between shoppings.**

APEXIOR NUMBER 1 is applied in thousands of locomotive boilers subject to Interstate Commerce Commission inspection.

Supplements Feedwater Treatment

APEXIOR NUMBER 1 is brush-applied and therefore is not a substitute for feedwater preparation or chemical treatment. It is inert to all the chemicals generally used and supplies protection for metal in service under boiler water and steam temperatures and pressures, supplementing the work of the chemist and water service engineer by increasing the durability and raising the service quality of the boiler metal.



APEXIOR NUMBER 3

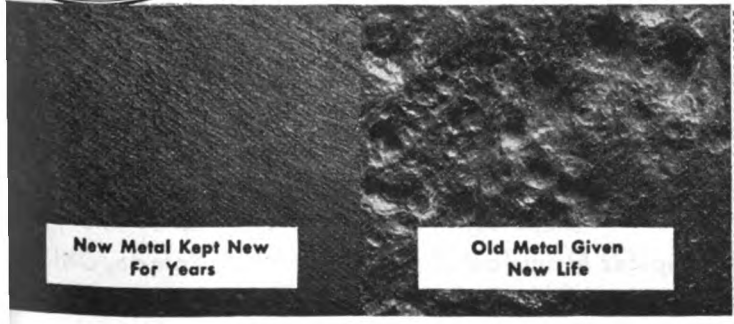
This brush-applied, durable coating protects the water space of locomotive tenders. It air-dries to a chemically inert, shiny-black film, resistant to water or moisture and chemicals used in water conditioning. It does not affect potability of water. Picture shows interior of tender cistern 21 months after surface at right was coated with APEXIOR NUMBER 3. Corroded surface at left was not coated, for comparative test.

See *Locomotive Cyclopoedia*. And write for Bulletin:

APEXIOR

Keeps new metal new . . . Gives old metal new life

DAMPNEY



THE DAMPNEY COMPANY OF AMERICA
Hyde Park, Boston 36, Mass.

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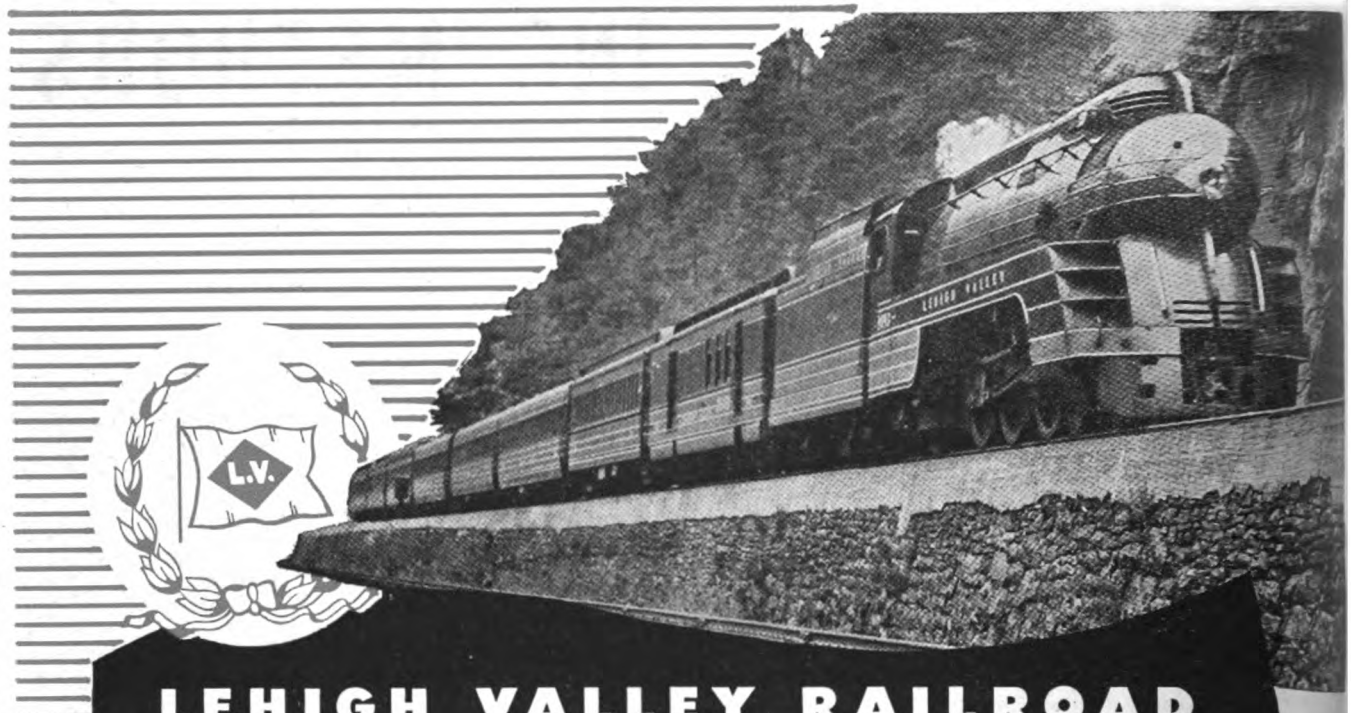


LEHIGH VALLEY RAILROAD uses the SPICER *Positive* Generator Drive

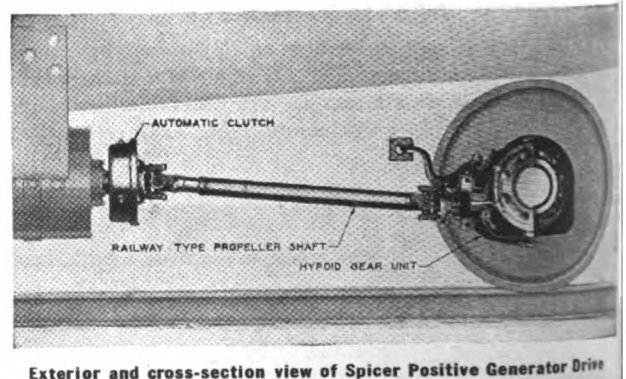
Spicer-equipped trains span the nation. Here's another one—it's a Lehigh Valley Railroad streamliner, and it's one of the more than 2000 Spicer Drive installations used by 27 different railroads all over the country.

The Spicer Positive Generator Drive will help you solve many of the service and comfort requirements of today's railway travel.

The modernization of existing cars, and the development of new cars incorporating high standards of passenger comfort, will require increased and more dependable electrical power to operate satisfactorily with the expanded use of air conditioning, improved lighting, electro-mechanical water coolers, radio, electric kitchen equipment, etc., and other improvements to come. Cars will operate generally at higher speeds and will be much quieter and smoother. All of these are factors emphasizing the importance of using a reliable generator drive.

The simple means of applying the Spicer Drive makes it readily adaptable to both old and new cars with few, if any, changes necessary in the car, truck or axle construction.

Other Spicer features include high efficiency and economy, safety, quietness and smoothness. Write for full details and literature describing *all* the profitable advantages Spicer Positive Generator Drives make available to you.



Exterior and cross-section view of Spicer Positive Generator Drive

42 YEARS OF Spicer SERVICE

Positive Generator Drive

Manufactured, Sold and Serviced by

Spicer Manufacturing Corporation, Toledo, Ohio

MODERN HANDLING METHODS

Now a Must!

There's no time to lose in getting operating costs on a competitive peace-time basis. Modern methods of handling are now a *must.* Electric industrial trucks, for example! Palletized loads! And, of course, the newest development in motive power Storage Batteries . . . the sensational Philco **"Thirty" that gives 30% longer life! Try Philco "Thirty" in your hardest-working trucks. The tougher the job the better it shows up. Write for the facts today.**

● **The new Philco "Thirty" Industrial Truck Storage Battery, that gives 30% longer life, is identified by its distinctive red connectors.**

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Famous for Quality the World Over

FOR 50 YEARS A LEADER IN INDUSTRIAL STORAGE BATTERY DEVELOPMENT

Tune in The Radio Hall of Fame, with Paul Whiteman and His Orchestra, Sundays, 6 P.M., EST; The Breakfast Club with Don McNeill, 9:45 A.M., EST, Monday through Friday—ABC (Blue) Network.

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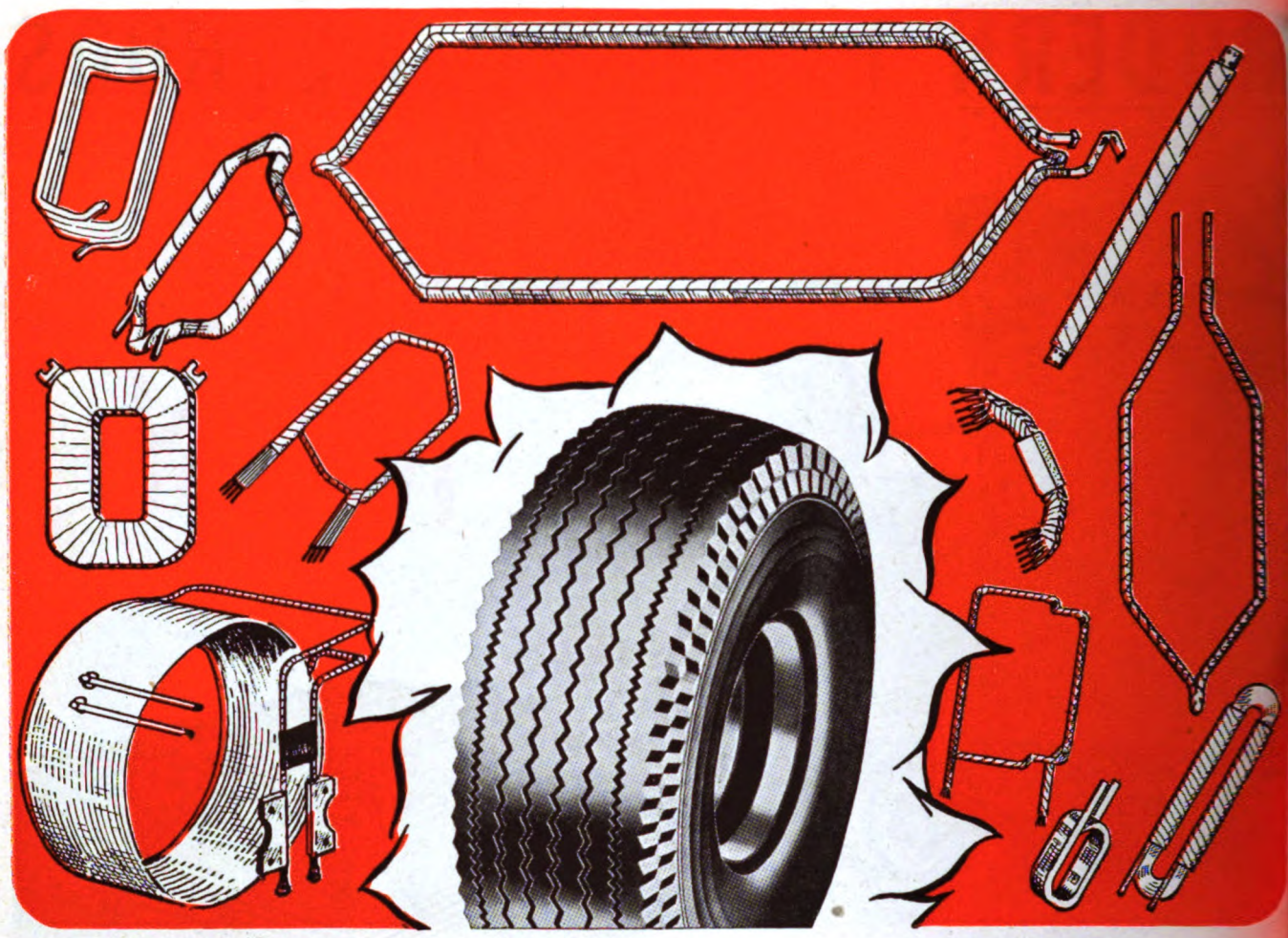

SECOND-GRADE TIRES DON'T PAY . . .

And the Same Goes for Electric Coils

• Tires and coils have one big thing in common. The man who depends on automobile travel to make his living buys the best tires he can find . . . the operation which depends on electric power needs the best coils which can be had. Premature failure means lost production in either case.

Four-ply tires are standard on new passenger cars. But the hard-riding salesman puts six-plies, or "deluxe" four-plies, on his car. He wants no tire trouble; he wants to reach that appointment on time. Do you?

National coils "get you there on time." When standard construction can do the job, we furnish the best. But no rigid production-line technique cripples our ability to design and build special coils to overcome the causes of persistent, recurring coil trouble. When your electrical unit fails, call in National . . . the failure will be analyzed to determine its cause . . . replacement coils will be engineered to give you the longest possible coil life under the conditions imposed. If your conventional winding is merely changed to Mica-Glas or your old winding is completely modernized, it is because the change will benefit you in lower operating and maintenance costs.

Call in National. It will pay you.

★ **NATIONAL ELECTRIC COIL COMPANY** ★

COLUMBUS 16, OHIO, U. S. A.

ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION—

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REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

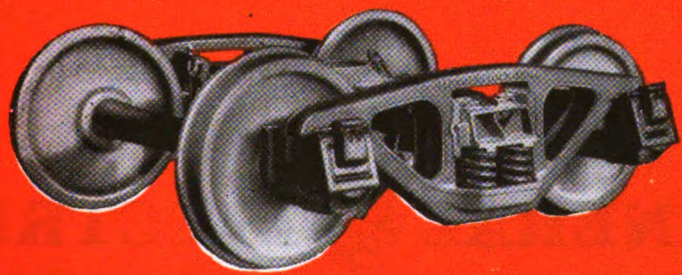
Coil springs develop their best riding qualities in the A.S.F. Ride-Control Truck. Constant friction control prevents spring resonance, yet allows maximum possible freedom of movement for natural cushioning effect— gives lading a smooth ride at all loads and speeds.

MINT-MARK OF ⬡ FINE CAST STEEL

Over 17,200 sets of this modern freight car truck are already in service or on order by 44 railroads and private car owners.

A·S·F *Ride-Control* TRUCK (A-3)

NO SPRING PLATES—NO SPRING PLANKS



LONG SPRING TRAVEL • CONSTANT FRICTION CONTROL

AMERICAN STEEL FOUNDRIES

CHICAGO

Overhead. *G-E fluorescent lamps in continuous lines of light impart a cheerful atmosphere to this dining car interior. G-E incandescent lamps give added down light over the tables.*

Good lamps are the heart of good lighting

FILAMENT

FLUORESCENT

SLIMLINE FLUORESCENT

The Constant aim of General Electric Lamp Research is to make G-E Lamps Stay Brighter Longer

For tomorrow, G-E Slimline lamps will join with G-E fluorescent and filament lamps to bring you new help, greater service from lighting.

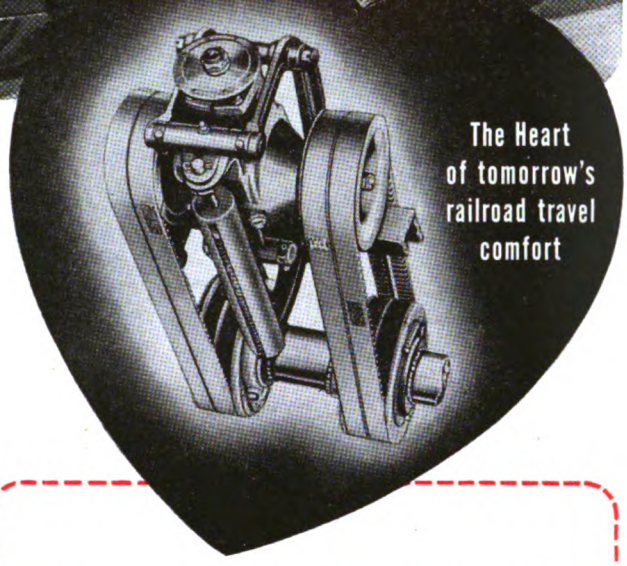
G-E LAMPS

GENERAL ELECTRIC

HOW TO LIVE COMFORTABLY—
—at 60

THE DRAWINGROOM-BEDROOM CAR

Another new idea that will make railroads tomorrow's preferred form of travel.



The Heart of tomorrow's railroad travel comfort

. . . and the world's most dependable under-car drive guarantees that comfort!

Yes . . . whether you're speeding along at 60 miles an hour or faster, you'll live in gracious comfort in this newest creation of railroad car designers. By day a luxurious, spacious drawing room, by night a comfortably-appointed bedroom . . . with a private, enclosed bath attached. It's travel comfort *de luxe*. That is, it is if the under-car drive that provides the power for air conditioning, lighting, and other electric requirements does not fail. Because this power source must not fail, forward-thinking railroad car designers and managements are specifying more Dayton "D-R" V-Belt Axle Drives for luxury cars than any other make. They know that these Dayton Drives provide the highest performance and safety factors of any under-car drive built. Let a Dayton railway specialist show you proof why Dayton "D-R" V-Belt Axle Drives are preferred two to one. Write to

THE DAYTON RUBBER MANUFACTURING COMPANY
DAYTON 1, OHIO

Railroad V-Belts by

Dayton Rubber

REG. TRADE MARK — THE DAYTON RUBBER MFG. CO

THE MARK OF TECHNICAL EXCELLENCE IN SYNTHETIC RUBBER

Advantages of the Dayton "D-R" V-Belt Axle Drive

1. *Quiet and smooth performance with high availability—in 15 years a mechanical failure due to V-Belts has never been reported.*
2. *Provides a flexible, cushioned connection between the car axle and the driven unit that protects generators and other equipment should a mechanical failure occur.*
3. *It is convenient and economical to install . . . no complicated or expensive truck changes are necessary . . . no special axles are necessary.*
4. *Duplicate equipment is not necessary to take care of emergencies—when wheel changes must be made, only the axle pulleys need to be removed.*
5. *It greatly reduces maintenance cost on mechanical equipment as well as on the drives themselves.*
6. *It imposes a minimum weight on the car axle.*
7. *It is easy and simple to install, safe and dependable in operation, and insures uninterrupted performance.*

★ 40 YEARS OF RESEARCH IN NATURAL AND SYNTHETIC RUBBER ★

MAKERS OF *History*—

Chicago and North Western—Union Pacific "City of Denver" and "City of Los Angeles" meeting in Chicago

Here are makers of railroad history . . . streamliners that regularly maintain whirlwind schedules on two of America's longest, toughest runs. A 1047-mile dash daily between Chicago and Denver . . . a 2299-mile race between Chicago and Los Angeles every third day! These are triumphs of Chicago and North Western—Union Pacific operation of crack fleets.

Back of this success is Diesel dependability . . . and *correct* lubrication. Chicago and North Western and Union Pacific use Sinclair Gascon Oil for lubrication of the Diesel locomotives hauling these outstanding trains.

Sinclair Gascon gives cool engine operation with absence of deposits that cause ring sticking and carbon troubles. Its wear-prevention qualities hold down expensive replacements. Let our Engineers tell you more about the advantages of using Sinclair Gascon Oils.

SINCLAIR RAILROAD LUBRICANTS

SINCLAIR REFINING COMPANY, *RAILWAY SALES*, NEW YORK • CHICAGO • SAINT LOUIS • HOUSTON

Only Honeywell Offers

"FULL MODULATION"

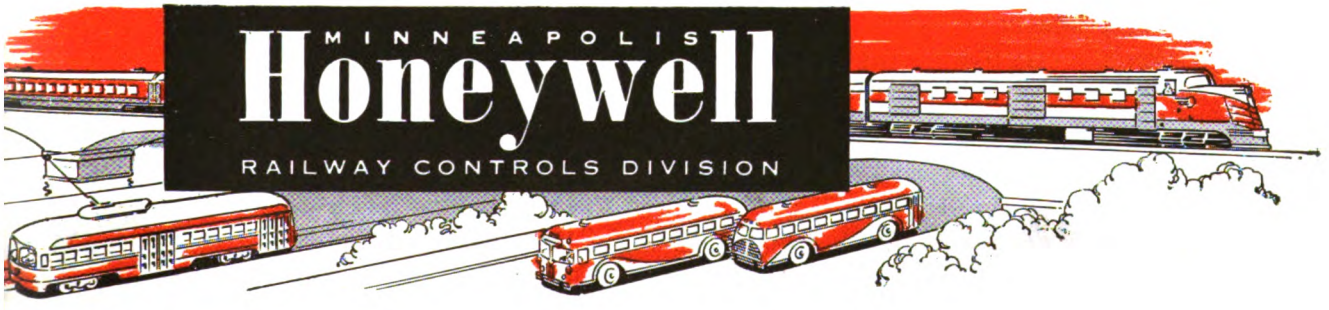
DIESEL ENGINE SHUTTER CONTROL

Full modulation control means accurate and positive positioning of the diesel engine radiator shutters. It means that only enough air is permitted to pass through the radiators to maintain engine cooling water and oil temperatures at exactly the degree required, regardless of outside temperature, speed or load conditions.

Contrast full modulation control to the conventional "off-on" system, which means periodic delivery of cooling air with an alternately hot and cold engine cooling water condition, which obviously cannot be as efficient as constant proper temperature.

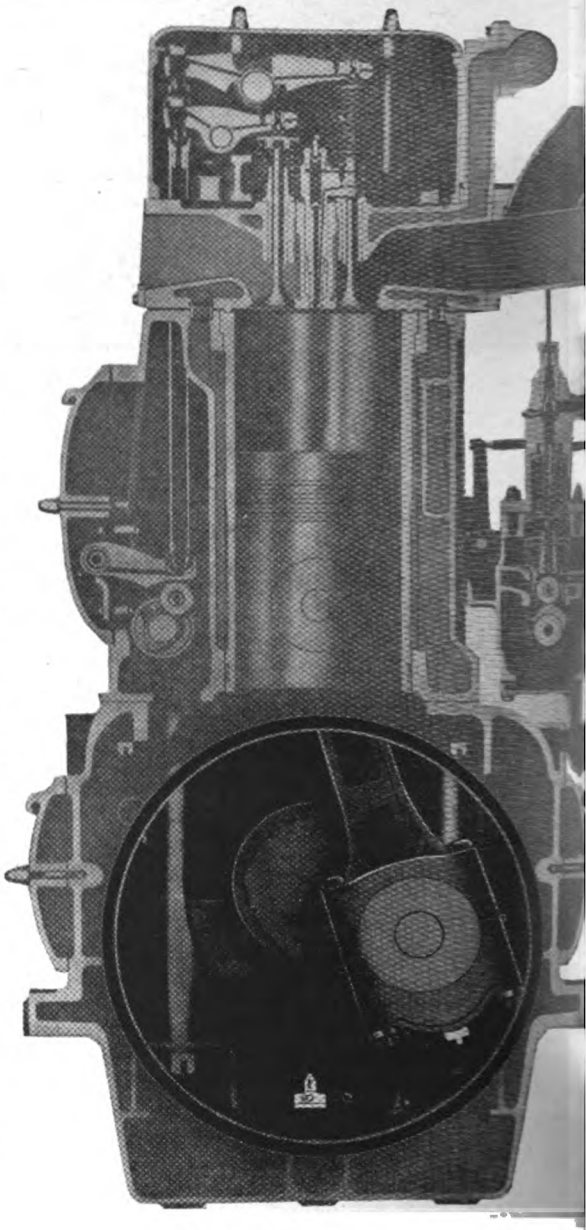
The modulating feature of the Honeywell Shutter Control System makes possible not only full modulation of the shutters, but also permits step or sequence control of shutters and fan operation. Honeywell full modulation control is fully automatic. It is simple, safe and foolproof, as evidenced by hundreds of thousands of miles of actual service on freight and passenger runs from coast to coast and from Canada to the Gulf, under all types of varying weather and load conditions.

If you are not already familiar with the Honeywell full modulation diesel engine shutter control system, write Minneapolis-Honeywell Regulator Company, Railway Controls Division, 433 East Erie Street, Chicago 11, Illinois.



NOW AVAILABLE

Extra Protection for Diesel Engines



Protect the heart of your Diesel Engines by installing the Bearing Watchdog System. With this tried and proved crankshaft protector, wear beyond predetermined limits or shellout of connecting-rod and main bearings can be detected in plenty of time to prevent any damage to the crankshaft.

The system can be operated either pneumatically or hydraulically. Under pneumatic operation, it is connected to an external air supply, and a constant air pressure of from ten to fifteen pounds is normally maintained. No electrical circuits enter the crankcase.

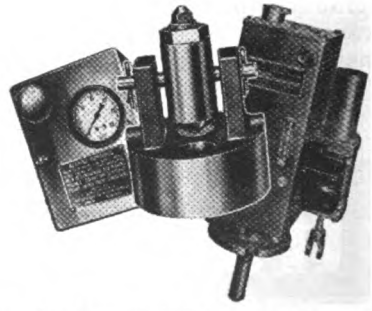
An adjustable "watchdog" or trip-lever installed under each connecting-rod throw, and a lug attached to each connecting-rod bearing cap, provide the points of contact which sets the system into action. Other units of the system include a dump-valve which can be attached to the Serv-O-Motor of any standard hydraulic governor, and a control box containing an air-pressure reducing valve and tell-tale light. The various parts are connected by copper tubing.

Allowing for expansion and flexing in the engine, the clearance between the Watchdog and the lug is set to represent the maximum amount of wear permissible. If a connecting-rod bearing or main bearing wears excessively or shells out, the lug strikes and trips the Watchdog, releasing the pressure from the system which activates the dump valve on the governor. This effects an immediate engine shutdown and simultaneous lighting of the tell-tale light.

Protection is also afforded if a main bearing goes out, because the crankshaft will flex sufficiently to trip the Watchdog. The engine is protected in case of broken connecting-rod caps, broken cap-bolts or connecting-rods, because anything that releases the air pressure from the Watchdog System causes an almost instantaneous engine shutdown.

Write today for illustrated folder and complete details about this important crankshaft protector!

- **PROTECTS THE CRANKSHAFT**
- **PERMITS MAXIMUM BEARING WEAR**
- **MAKES FREQUENT BEARING INSPECTION UNNECESSARY**
- **LOCATES FAULTY BEARING INSTANTLY**
- **OPERATES EITHER HYDRAULICALLY OR PNEUMATICALLY**
- **SIMPLE . . . POSITIVE . . . HAS LOW MAINTENANCE FACTOR**
- **PROTECTS THE ENGINE**



We invite inquiries from Diesel Owners and Operators, Diesel Designing Engineers and Diesel Manufacturers.

D·E

PAXTON DIESEL ENGINEERING COMPANY—OMAHA 5, NEBRASKA ★ *A Subsidiary of Paxton-Mitchell Company, Mfgs. of P-M Metallic Rod Packi*

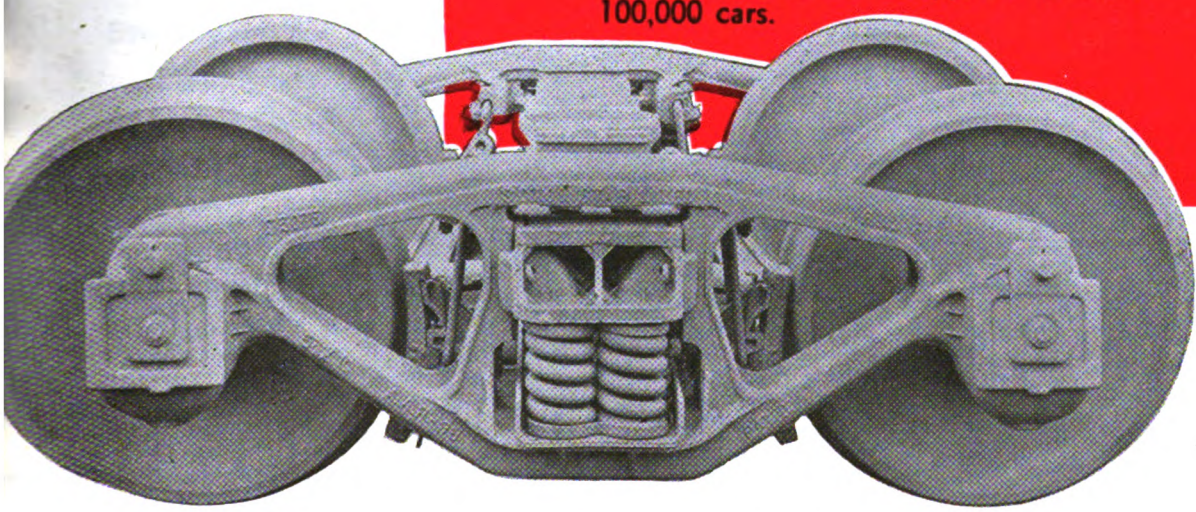
BEARING WATCHDOG SYSTEM

"Stabilized"

means "an asset!"

Webster's may not define it that way, but "STABILIZED" means "an Asset" to the railroad and to the shipper when it is used in Barber STABILIZED Trucks. Barber STABILIZED Trucks by controlling the ride of freight cars assure the shipper that goods will reach their destination safely. Barber STABILIZED Trucks by preventing harmonic bounce, bolster and column wear and spring breakage assure the railroad economic operation.

Yes, 56 different railroads and private car lines have found that "STABILIZED TRUCKS" means "an Asset" because they have now been supplied for over 100,000 cars.

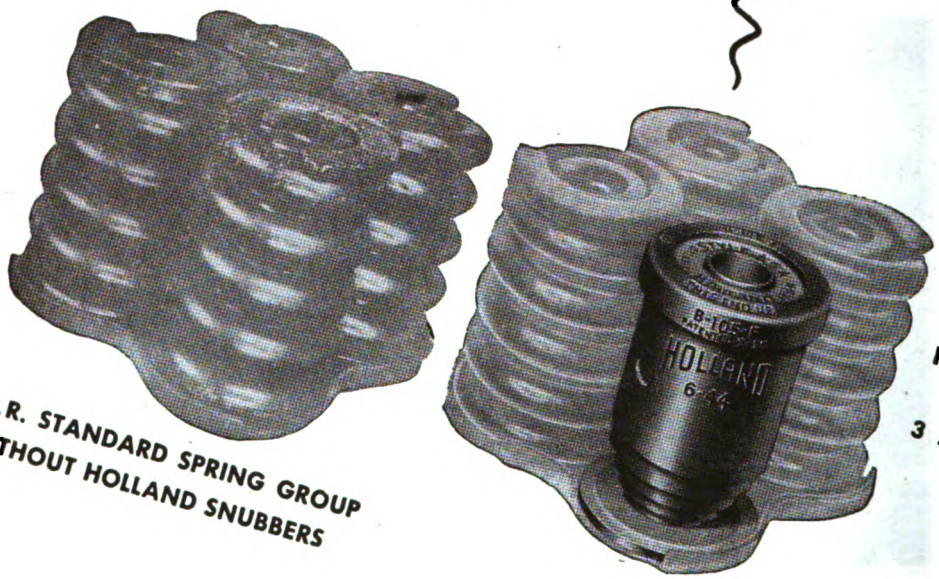


STANDARD CAR TRUCK COMPANY

332 SOUTH MICHIGAN AVENUE CHICAGO 4, ILLINOIS

Stop Coil Springs from Jitterbugging!

★ This is what Oscillation Curves prove about the movement of your coil spring groups in operation.



A. A. R. STANDARD SPRING GROUP WITHOUT HOLLAND SNUBBERS

HOLLAND SNUBBER SPRING AND 3 A. A. R. SPRINGS

Style A-6-A Holland *Volute* Snubber Springs

HOLLAND COMPANY

332 SOUTH MICHIGAN AVENUE, CHICAGO, ILLINOIS

WE DON'T LET 'EM DOWN WHEN THE TEMPERATURE GOES UP!

Sturtevant Air Conditioning Makes High Temperature Shut-Offs A Thing of the Past!

HERE IS AN AIR CONDITIONING SYSTEM that will keep running *without interruption* – even when you're operating in the highest ambient temperatures to be found in the United States. You can forget about exceptionally high outside temperatures – such as you find in the southwest–that would ordinarily cut-out the system.

With the Sturtevant Evaporative-Condenser Unit, an extra cooling effect produced on condenser coils liquifies the Freon gas inside, and reduces pressure to a level well under safety limits. Suspended underneath the car, the Evaporative-Condenser sprays large quantities of water over the coils, then evaporates the water with a blast of air. Built for continuous operation over great distances, the unit is provided with a 175-gallon stainless, leak-proof, steel tank which supports a motor driven pump.

This Unit is but one of several new types of Sturtevant Railroad Equipment. Whether your operations demand simple pressure ventilation or a complete air conditioning system, it will pay you to talk with a Sturtevant Engineer.

B. F. STURTEVANT COMPANY
Division of Westinghouse Electric
HYDE PARK BOSTON 36, MASS.
Branch Offices in Principal Cities

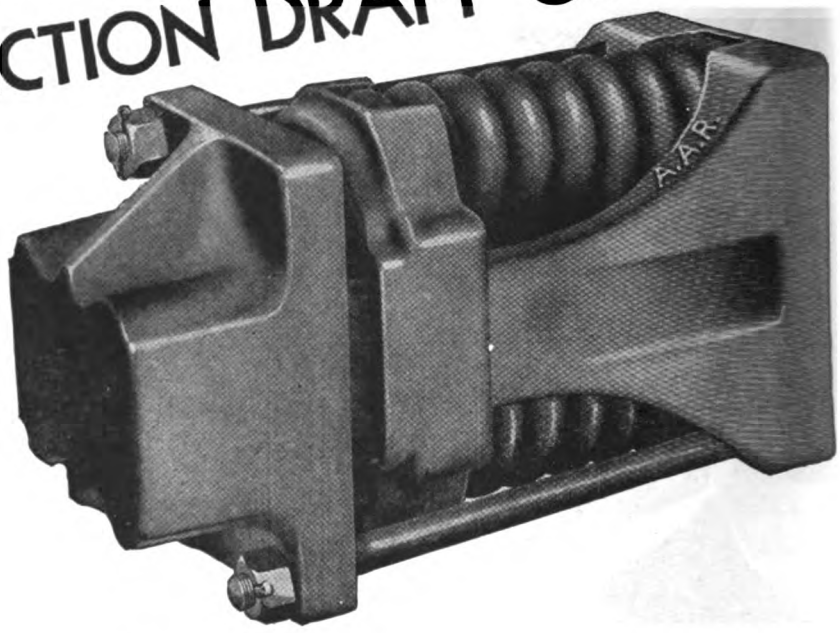
STURTEVANT GIVES YOU ALL 4 RAILROADING ADVANTAGES

1. More uniform temperature and humidity conditions in the car.
2. Equipment designed for easy maintenance.
3. Equipment designed for minimum space and weight.
4. Equipment that requires a minimum power load.

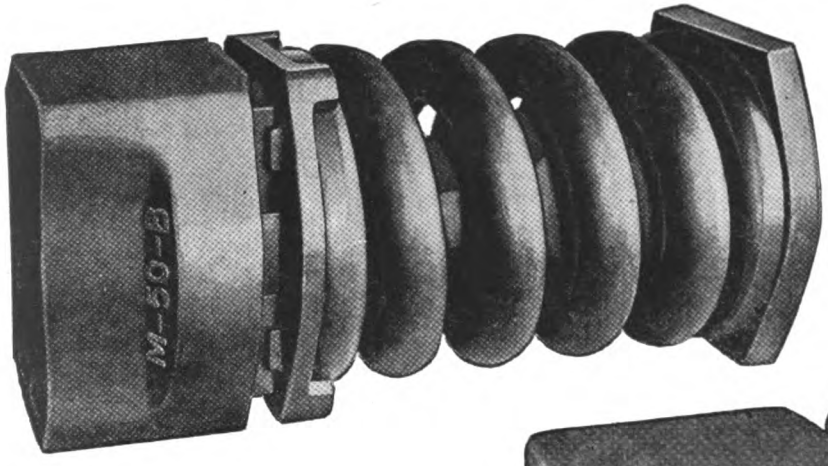
Sturtevant
Puts Air to Work

STURTEVANT "Railvane" Units or Systems are used by 40 railroads and are covered by more than 80 issued patents and patents pending

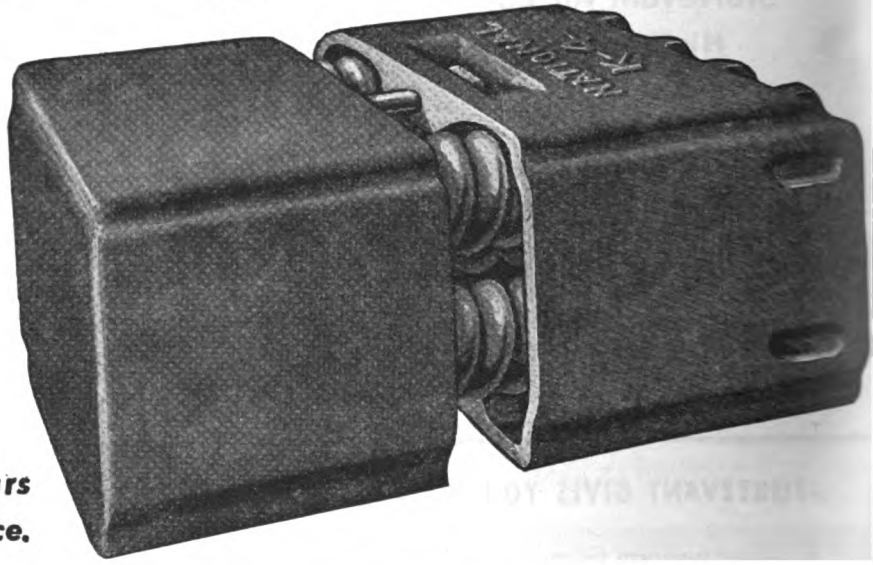
NATIONAL FRICTION DRAFT GEARS



NATIONAL M-17-A DRAFT GEAR
22 3/8" long
A.A.R. Approved



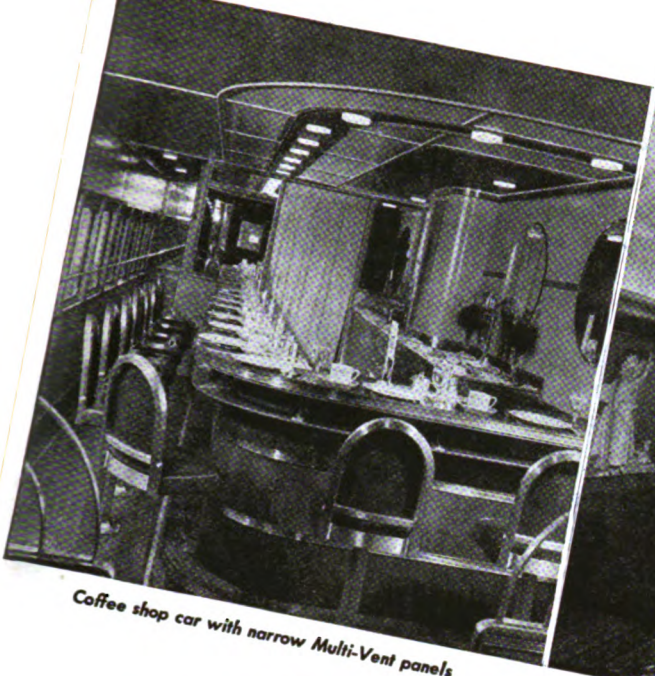
NATIONAL M-50-B DRAFT GEAR
20 1/8" long
A.A.R. Approved



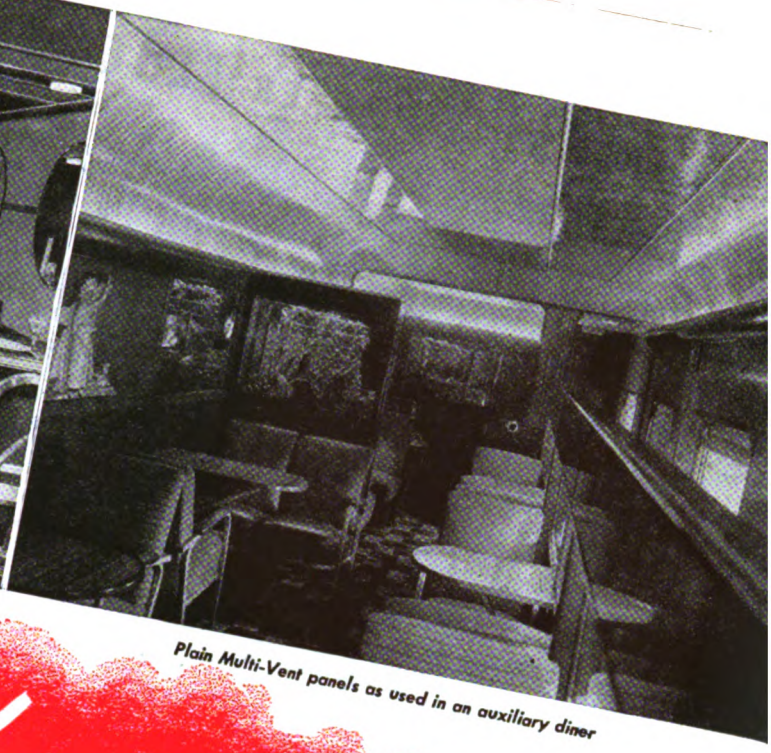
NATIONAL K-4 DRAFT GEAR
Designed especially to meet the requirements of high speed passenger service.

Specify NATIONAL Draft Gears for efficient, economical service.

NATIONAL MALLEABLE AND STEEL CASTINGS CO.
General Offices: CLEVELAND, OHIO
Sales Offices: New York, Philadelphia, Chicago, St. Louis, San Francisco
Works: Cleveland, Chicago, Indianapolis, Sharon, Pa., Melrose Park, Ill.

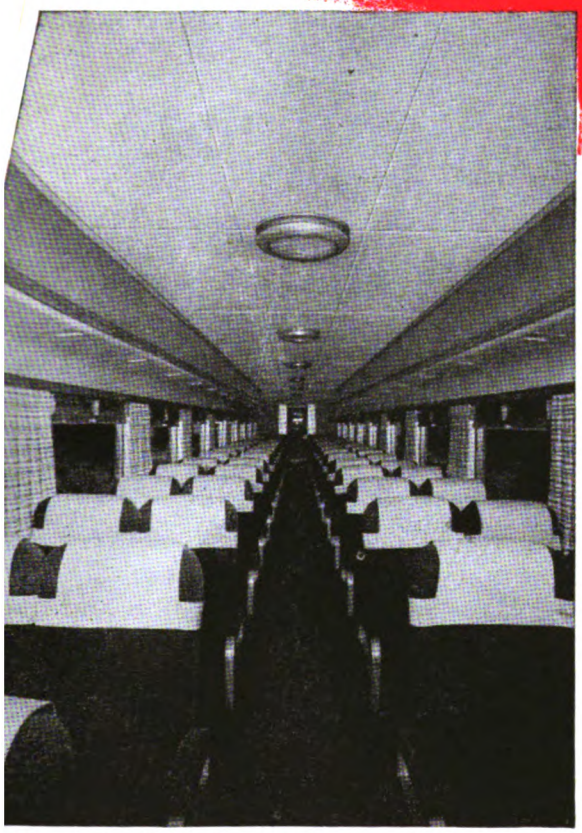


Coffee shop car with narrow Multi-Vent panels



Plain Multi-Vent panels as used in an auxiliary diner

proved passenger comfort



Multi-Vent panels with incandescent lighting fixtures, in deluxe coach

MULTI-VENT is an exclusive method for delivering air through ceiling panels to occupied spaces. It provides the efficient air distribution, without drafts, required for passenger comfort in modern railway equipment.

MULTI-VENT draftless ventilation is serving in many hundreds of cars, in all parts of the country, and has proved its ability to provide uniform temperatures and all the other features contributing to comfort.

MULTI-VENT is easily installed in any type of car and can be used with any type of lighting equipment. Write for Bulletin No. 6110 giving examples of many types of applications.

The Pyle-National Company

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Export Department: International Railway Supply Co., New York

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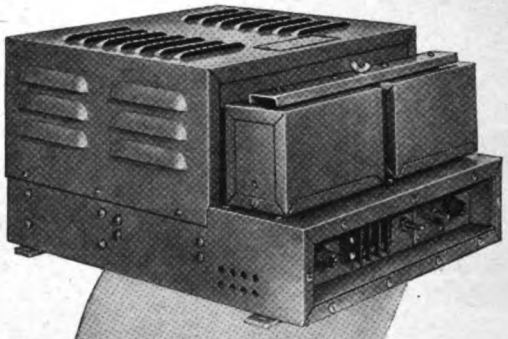
YOUR PASSENGERS PREFER FLUORESCENT LIGHTING



RAILWAY FLUORESCENT LIGHTING NEEDS E·L DC-AC CONVERTERS

In the competitive transportation field of today modernization is recognized as a necessity. For passenger illumination the trend is definitely toward fluorescent lighting.

E·L VIBRATOR CONVERTERS MOST EFFICIENT. E·L Vibrator Converters are the most efficient and economical means of providing your coaches, diners, lounge cars and sleepers with modern fluorescent lighting.

FOR RADIO EQUIPMENT, TOO. Two-way radio operation of trains is also provided for by the E·L Vibrator Converter. It is likewise the means of giving your passengers the extra convenience of standard radio reception and electric razor outlets.

DESIGNED FOR RAILWAY USE. With railway needs in mind, E·L developed a compact, lightweight power conversion system. It operates ten 42" Slim-Line fluorescent lamps from 32 volts DC or any other input voltage desired. For larger number of lights, multiple units may be used.

This E·L system incorporates dual series circuits and the simplicity of series wiring. It provides more than 30 lumens of light per input watt as compared with less than 15 lumens per watt for old fashioned incandescent types. Individual lamp control is available where required and a constant level of light is assured by inherent voltage regulation.

TESTED IN RAILWAY USE. In actual railway car installations, E·L Vibrator Converters have been tested and reliability thoroughly proved over a period of years.

For railway fluorescent lighting, you need E·L DC-AC Converters.

E·L FLUORESCENT DC-AC CONVERTER. Model 2026 operates ten 42" Slim-Line fluorescent lamps. Providing instantaneous starting and high efficiency, it is available for these input voltages: 12, 24, 32, 110, or 600 volts DC.

Dimensions are 14⅝ x 13 x 8.

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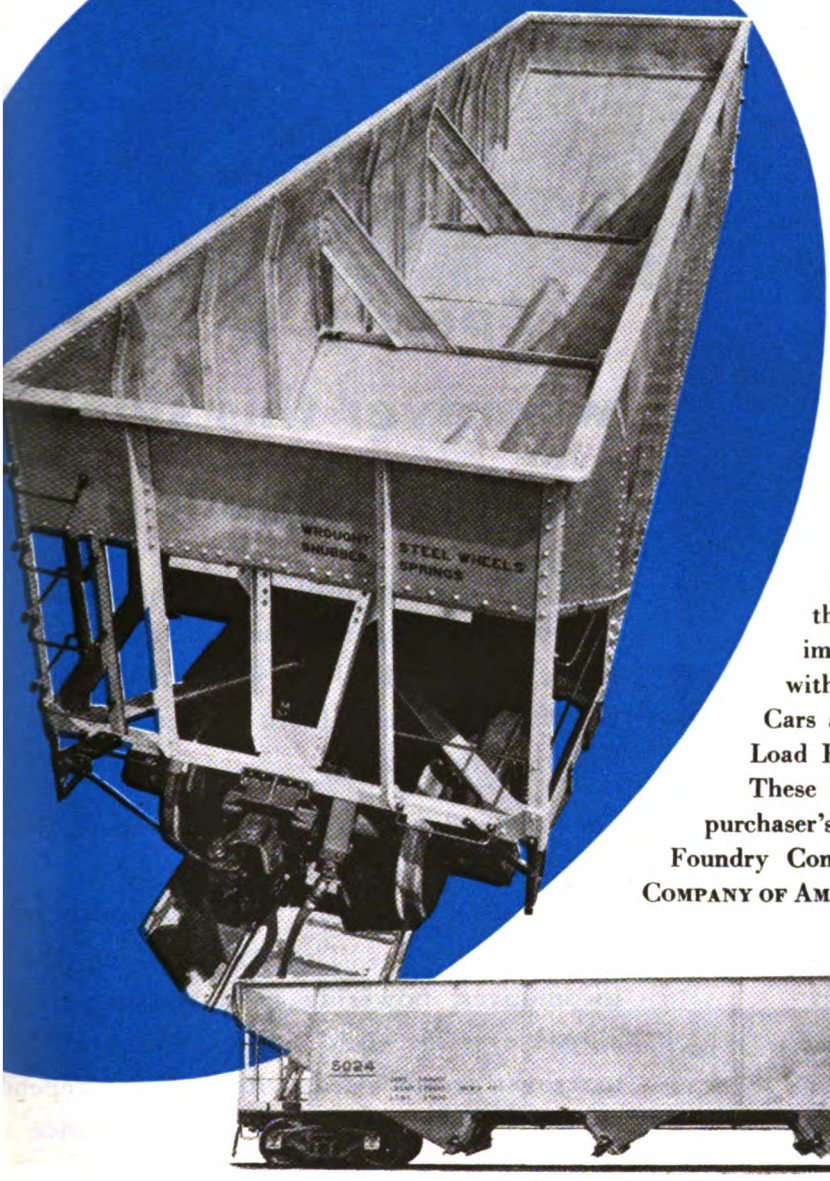
INDIANAPOLIS

VIBRATORS AND VIBRATOR POWER EQUIPMENT FOR LIGHTING, COMMUNICATIONS, ELECTRIC AND ELECTRONIC APPLICATIONS

DEADWEIGHT CUT 26%
N TWENTY-FIVE NEW HOPPER CARS

MADE OF

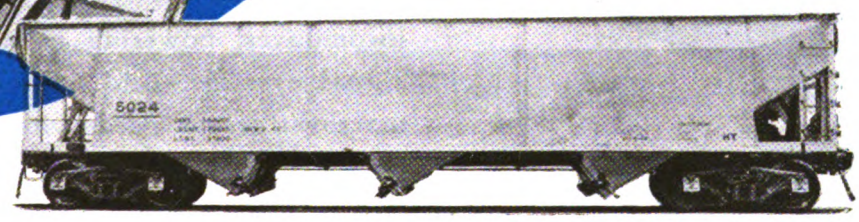
Alcoa Aluminum



Twenty-five 70-ton hopper cars made of Alcoa Aluminum by the American Car and Foundry Company for a leading southwestern railroad are now off the production line. Aluminum alloy is used for the entire body of these cars, except the center sill and bolster, which are made of steel.

Average scale weight, empty, is 37,000 pounds per car, compared with an average of 50,100 pounds for the conventional all-steel 70-ton hopper car —a saving of 26% in deadweight. The aluminum car carries 6½ tons more than the corresponding A.A.R. steel car without imposing any more weight on the axles and without requiring any more locomotive power. Cars are equipped with Type AB Empty and Load Brake.

These aluminum hopper cars were designed to purchaser's specifications by American Car and Foundry Company and Alcoa engineers. ALUMINUM COMPANY OF AMERICA, 1929 Gulf Bldg., Pittsburgh 19, Pa.



MADE OF ALCOA ALUMINUM; WEIGHS ONLY 37,000 POUNDS

ALCOA FIRST IN ALUMINUM

REG. T. M.

ALCOA ALUMINUM

Specify EXIDES wherever this symbol appears in your plans

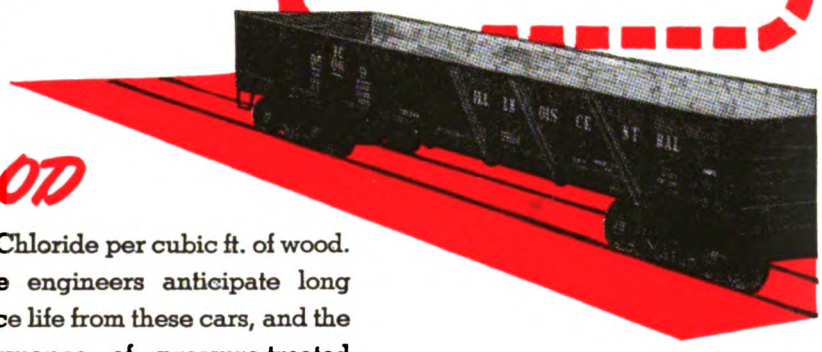
Extra electrical innovations, which form a part of most plans for the fine new cars soon to come, call for added power—trustworthy and economical power. All are assured when Exide batteries are specified.

On thousands of coaches and Pullmans, Exide Ironclads are keeping cars bright and air-conditioning units functioning smoothly even during long stops. They are cranking Diesel locomotives, powering train telephones and signal systems. And Exides will serve tomorrow's greater needs with the same dependability, long-life and ease of maintenance as they have since 1891.

Exide
IRONCLAD
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • Exide Batteries of Canada, Limited, Toronto

500 Coal Cars equipped with "Life Preservers" by the Illinois Central Shops



KOPPERS PRESSURE-TREATED WOOD

This composite hopper-bottom car is one of 500 coal cars built at the Centralia, Illinois shops of the Illinois Central Railroad, in which pressure-treated wood was used for composite bottoms and sides.

Dense short-leaf yellow pine, pressure-treated with creosote to a final net retention of 6 lb. per cubic foot, was installed in the car bottoms. Sides, which were also dense short-leaf yellow pine, were pressure-treated with ¾ lb. Chromated Zinc Chloride per cubic ft. of wood.

The engineers anticipate long service life from these cars, and the performance of pressure-treated wood in other applications certainly justifies this expectancy. Wherever car material, notably decking, must take severe mechanical punishment or is subjected to decay, pressure-treated wood has given from two to three times the service of untreated material. Many so-called "mechanical" failures are actually induced by decay, which is combatted by proper treatment. The treated wood is not subject to corrosive attack, first cost is low, and maintenance is held at a minimum.

We will be glad to send you information on typical treatment specifications used by representative railroads, if you will write.

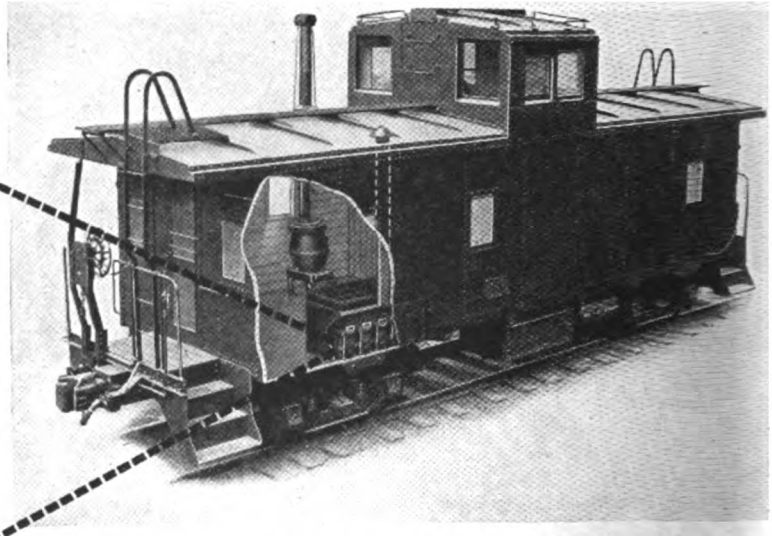
KOPPERS COMPANY, INC. • WOOD PRESERVING DIVISION
PITTSBURGH 19, PA.

KOPPERS

Buy Victory Bonds —and Keep Them!

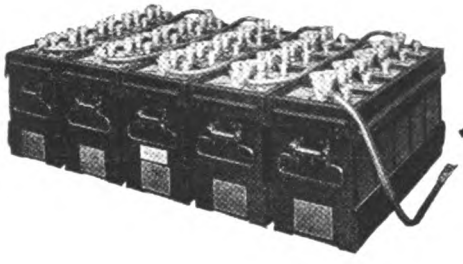
THE INDUSTRY THAT SERVES ALL INDUSTRY

You get these...
8 IMPORTANT ADVANTAGES
when Alkaline Batteries ride the Caboose



Typical installation of an alkaline battery under a caboose seat bunk

A 25-cell, 32-volt alkaline battery



As a POWER source for train communication equipment on caboose cars, Edison Alkaline Batteries provide the same outstanding advantages that account for their fine performance and long service records on railway passenger cars. Their construction and inherent operating characteristics . . . listed at the right . . . are your assurance that they will give (1) longer service life than can be obtained from other types of batteries, (2) unequalled dependability and (3) low operating costs.

Ask for Bulletin S. B. 1005. It is prepared to provide railroad and equipment manufacturers with electrical data, dimensions and weights for selecting batteries for this service. Edison Storage Battery Division of Thomas A. Edison, Incorporated, West Orange, New Jersey.

Edison
ALKALINE BATTERIES

- Alkaline batteries are *light in weight.*
- They are *durable mechanically;* because of their steel cell construction, they will withstand successfully the mechanical shocks incidental to freight train operation.
- They are *foolproof electrically;* are not injured by excessive charging or by overdischarging which are likely to occur as a result of run variations whether the caboose car is provided with generating equipment or the batteries are charged from yard power.
- They accept *charge rapidly;* can be completely charged at full normal rate up through the finish, or at higher rates for short periods regardless of state of charge.
- They *resist temperature extremes;* are not subject to injury by freezing.
- They can *stand idle indefinitely* without injury. Merely discharge, short-circuit, and store in a clean, dry place.
- They are *free from corrosive acid fumes;* may be installed in close proximity to delicate apparatus.
- They are *simple to maintain.*

SCULLIN MEANS STAMINA IN LOCOMOTIVE CASTINGS

Relentless Tests Show Strength to Spare

The most modern testing facilities and production controls—plus almost a half-century's rich experience — are your assurance of *unfailing dependability* in every Scullin casting.

ARMY ★ NAVY

SCULLIN STEEL CO

SAINT LOUIS 10, MISSOURI

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If you have a problem in heavy metal fabrication, a BEATTY engineer may have the answer. Write us when your next problem arises.

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New Fifth Edition of

LAYING OUT for BOILER MAKERS AND PLATE FABRICATORS

1944. 5th. 522 pages, 762 scale drawings, 20 photographs, index, 8½ x 11¼, $8.00

This standard layout book, first published in 1907, has been thoroughly revised and brought up to date. The locomotive boiler chapters have been expanded and new chapters added to cover Laying Out and Computing Boiler Patches and Laying Out for Welded Construction. Original chapters on sheet metal layout have been left in and layouts for plate fabrication added. The text has been entirely reset in easy reading type and the all new line drawings are sharp and clear. Written in shop language and without resort to higher mathematics.

Contents

The Subject of Laying Out—Triangulation—Cones and Spheres—The Tubular Boiler—Laying Out the Locomotive Boiler—Constructing the Locomotive Boiler—Laying Out and Computing Boiler Patches—Laying Out for Welded Construction—Elbows—Layout and Construction of Steel Stacks—Transition Pieces and Breechings—Pipe and Pipe Connections—Chutes, Conveyors, and Hoppers—Index.

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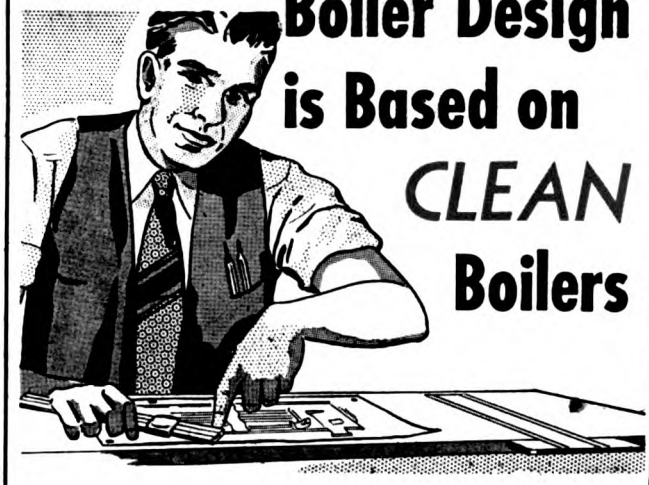
Boiler Design is Based on *CLEAN* Boilers



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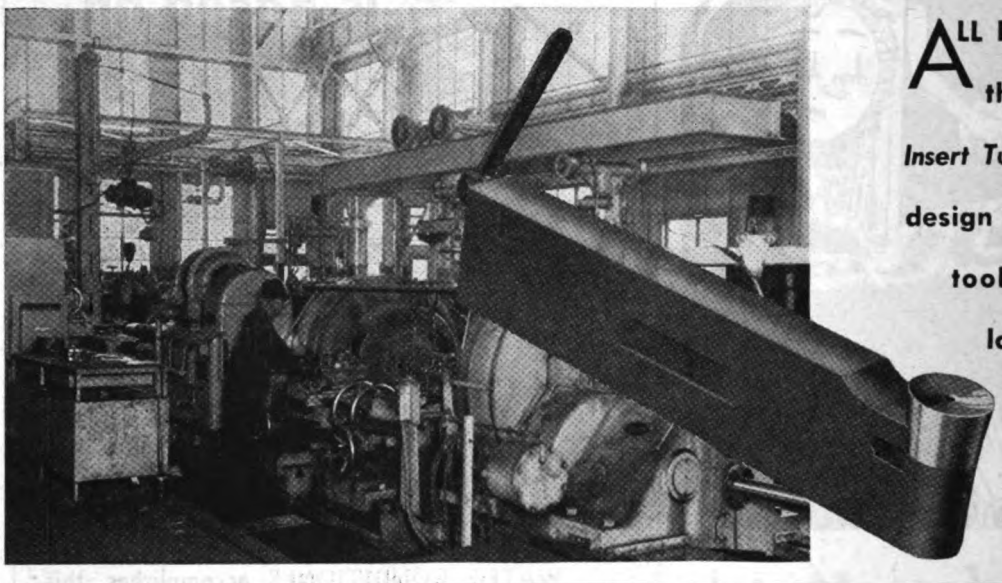

ALL PERFORMANCE tests of the *Gorham Serrated Shank Insert Turning Tool* prove that this design not only reduces original tool costs but also assures large savings in set-up and machining costs of locomotive driving wheel and car wheel tires.

GORHAM TOOL COMPANY

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JOURNAL BOX PACKING WASTE

To help your railroad in achieving better operation by eliminating waste grabs, waste wipes and rolling of the packing is the job of interwoven MILLERPAX Journal Box Packing Waste. One large railroad has been using MILLERPAX for more than one year with very desirable journal box results.

Interwoven MILLERPAX is available in either all wool, all cotton, or any combination of the two packings.

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To Keep Them Rolling . . .

Standardize on

EX-CELL-O

Hardened and Ground Steel Pins and Bushings . . .

for Diesel and steam locomotives and tenders, and passenger and freight cars

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Railroad Division

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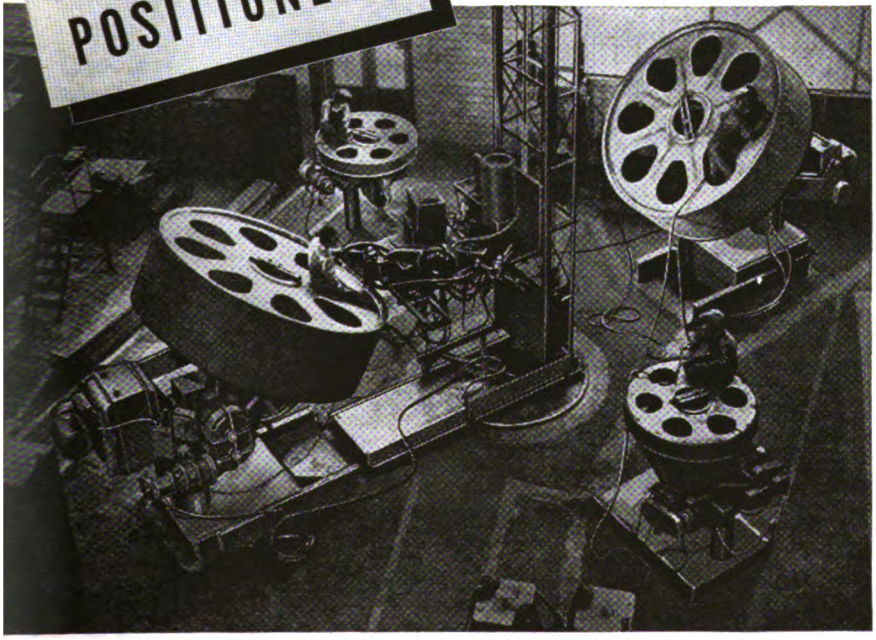
Detroit 6, Michigan

45—84

C-F POSITIONERS



. . . permit progressive automatic and hand welding

A "double production line"—in a 30 ft. square space handles all of the progressive steps of building up 2 sizes of large turbine gears simultaneously.

Four C-F Positioners are grouped radially around one automatic welding machine—2 No. 12s (1,200 lb. capacity) in diagonally opposite corners, 2 No. 140s (14,000 lb. capacity) in the other corners. With this arrangement, the single automatic welding machine can serve all 4 positioners and is used for all peripheral welds on the weldments. For this operation, the positioner rotates the tilted weldment under the electrode at any desired speed from 0 r.p.m. up. While the automatic welding machine is busy on one weldment, 3 welders are completing the hand welding operations on the other 3 C-F Positioners, which under push button control, turn and tilt weldment to any desired position permitting all welds to be easily made "down hand."

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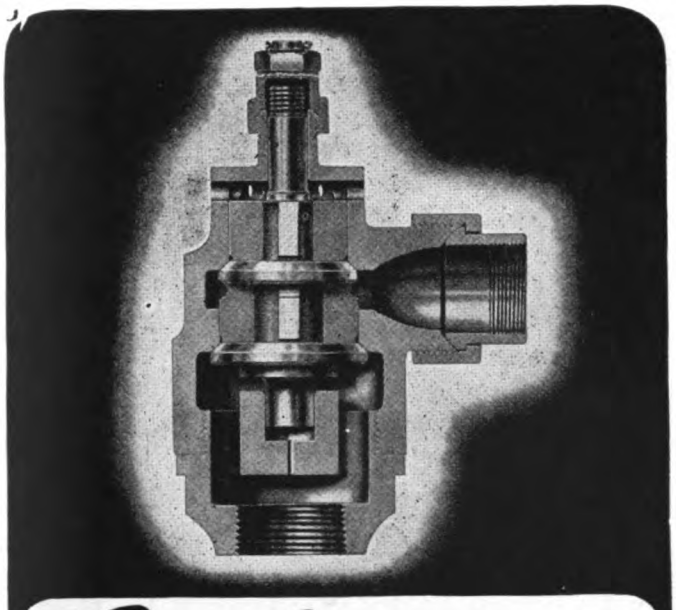

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BY-PASS VALVES

For Drifting Locomotives

These valves by-pass compression from one end of the cylinder to the other, and operate automatically with the throttle firmly closed, thus eliminating the use of steam while drifting. Vacuum is destroyed, lubrication is maintained, preventing the formation of carbon. This eliminates excessive wear on valve and cylinder packing, rings, and reciprocating parts. Operating tests have proven that a definite fuel saving results from the use of these valves; especially when drifting for periods of long duration. *Write for full particulars.*

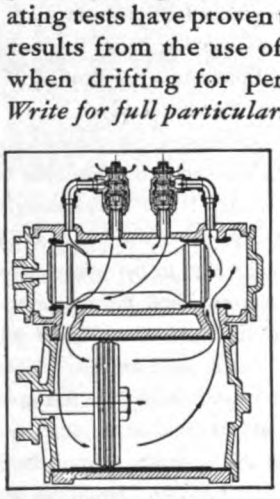


Fig. 1. Travel of cylinder contents at initial movement of piston while drifting. Reverse lever set at 50% cut-off. Main piston valve and both by-pass valves open.

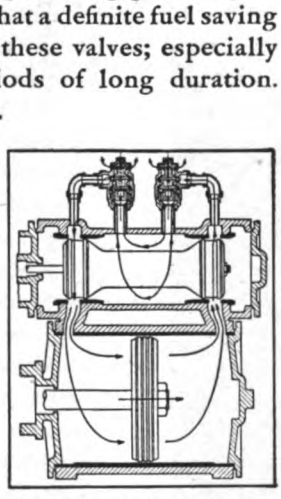


Fig. 2. Travel of cylinder contents with piston at 50% of stroke. Reverse lever set at 50% cut-off. Piston valve in lap position over cylinder ports and both by-pass valves open.

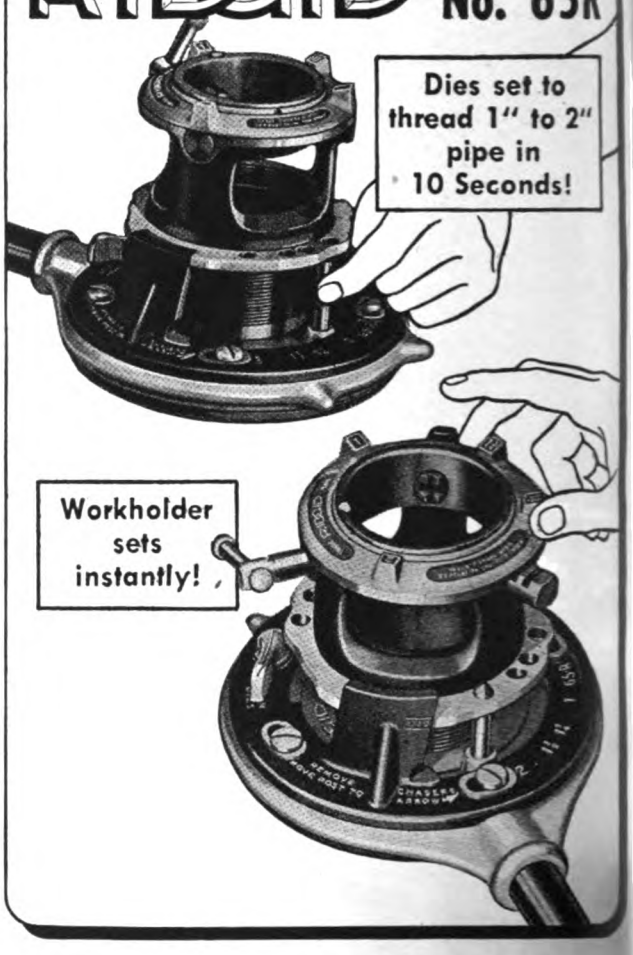
VILOCO RAILWAY EQUIPMENT CO.

332 SOUTH MICHIGAN AVENUE • CHICAGO

Precision Threads Quickly Easily

with self-contained semi-automatic

RIDGID No. 65R



• Save yourself time and effort in threading 1", 1¼", 1½" and 2" pipe. This rugged steel-and-malleable 65R gives you precision threads faster and with less effort than you've thought possible. You like the 10 second setting to size with one set of chasers that stay in the die stock (no extra dies to bother with) and the instant-setting foolproof workholder. Precision cut high-speed steel chasers and factory testing of every threader assure you of clean perfect threads, smooth faultless operation. For quicker easier threading buy the 65R at your Supply House.

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THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

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KING OF FLEXIBLE METAL HOSE!

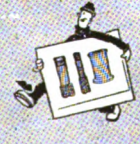
● There are reasons for leadership in every line. Better performance, finer quality, greater versatility and dependability . . . these and many more have given REX-WELD Flexible Metal Hose the high reputation it has today. A reputation that has earned the confidence of industry everywhere. Industrial men know the advantages of REX-WELD. For this rugged, seep-proof, airtight product has been out-performing ordinary connections on a wide variety of applications throughout industry.

Let "Flexon," the C.M.H. trademark character, show you in the sketches below some of REX-WELD'S outstanding features. Then ask us to give you the full story about REX-WELD and the other flexible metal hose products in our complete line.

REX-WELD . . . Handles steam with utmost safety. It is seep-proof to gas, oil, water and searching fluids. It is highly rust-resistant and non-deteriorating.

REX-WELD . . . operates efficiently under pressures up to 5,000 p.s.i., temperatures to 1,000° F. Greater strength and durability are the result of its 50-50 principle of corrugation . . . of an autogenous welding process that makes the weld stronger than the tube itself.

REX-WELD . . . is available in bronze and steel in sizes from 3/16-in. to 4-in. I.D. (incl.), with annular or helical corrugations, braided or unbraided depending on requirements. REX-TITE heatproof mechanical couplings are easy to install and are reusable.



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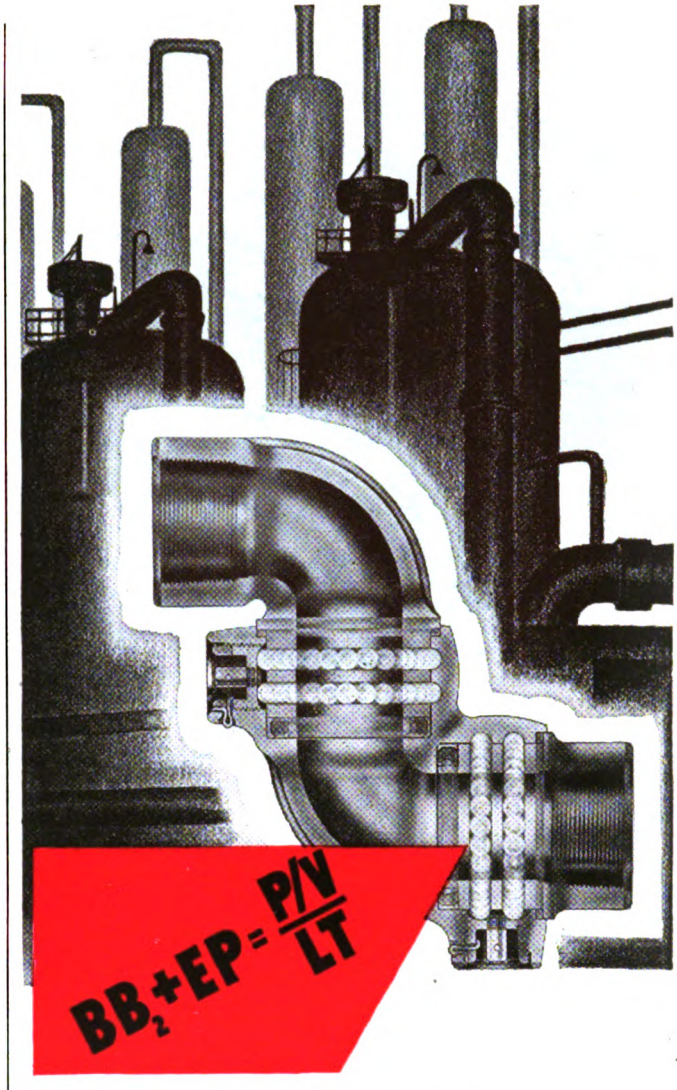
Plants: Maywood and Elgin, Ill.



THE CHIKSAN FORMULA

for perfect flexibility meets every demand of industry

CHIKSAN **BALL-BEARING** Swivels got their start and built their reputation for perfect flexibility in the Petroleum Industry. As this Industry became more and more important as a vital source of materials for the manufacture of synthetic products, Chiksan Swivels have proved their adaptability to every need . . . wherever flexibility is required . . . on lines handling steams, acids, alkalies, chemical compounds, gas, gasoline, etc. Many new applications have been developed to speed up production for war and for peace. There are over 500 different Types, Styles and Sizes of Chiksan Swivels. Tell us your requirements and we'll be glad to suggest those best suited to your specific needs.

REPRESENTATIVES IN PRINCIPAL CITIES

BB_2 = Double Rows of Ball Bearings
EP = Effective Packing Element
P/V = Pressure or Vacuum
LT = Low Torque under all conditions

CHIKSAN TRADE MARK REG. BALL BEARING SWIVEL JOINTS FOR ALL PURPOSES

CHIKSAN COMPANY
BREA, CALIFORNIA

ONE-MAN CONTROL OF ANVIL-FORGING JOBS

With the McKiernan-Terry Blacker Hammer one smith alone can handle any hand-forging operation without need of helpers around the anvil.

He can complete *in one heat* jobs that ordinarily require several. Thus he can greatly increase anvil capacity and output.

The Blacker is the only direct-geared, electric-motor-driven power hammer—no belts, pulleys or clutches.

Coordinated with a regular blacksmith's anvil, it places its speed and power under the smith's absolute control.

It can deliver light taps, heavy blows or alternate light and heavy. Single blows or up to 140 blows per minute.

Every blow flat and even, with the quick rebound of a hand sledge. Delivered on any part of the anvil. This permits a quick succession of operations without re-heats.

Requires no special gadgets—just the smith's familiar anvil tools.

READ HOW TO SAVE TIME AND MONEY

Get new Bulletin No. 56—"The Mechanical Blacksmith's Helper." Gives concise tabulation of advantages and savings. Pictures, diagrams, specifications. Free—just mail the coupon.

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Hair Is Nature's Own Insulation

It's nature's protective covering for animal life . . . it's a barrier against extreme outside temperature changes. HAIRINSUL is made of animal hair . . . one of the best reasons why HAIRINSUL is accepted as the finest of insulating materials for refrigerator cars.

AMERICAN HAIR & FELT COMPANY

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ALL HAIR INSULATION FOR REFRIGERATOR CARS

Quickly cuts steel up to 16 gauge

SKILSHEAR

ONLY 5½ LBS.

Cuts steel up to 14 gauge without distortion

SKILNIBBLER

ONLY 5 LBS.

BOTH OF THESE TOOLS . . . are compact, light weight (up to 3 lbs. lighter than other tools of similar capacity) . . . amply powered for fast cutting of hot rolled steel up to recommended capacity, softer materials in proportion . . . cool running, comfortable to the hand . . . elimination of customary handle gives operator complete control of tool in all positions. Ask your distributor today for a demonstration.

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PORTABLE ELECTRIC

SKILTOOLS

MADE BY SKILSAW, INC.

MINES

Cable Connectors

For Power Transmission

Single or Multi-Conductor

Heavy Duty

Water Sealed

Molded Rubber or Synthetic

Can Be Molded at Factory to Specifications on Your Cords or Cables

Stand Rough Handling and Difficult Conditions

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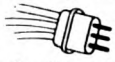


Carried in Stock in Standard Designs and Sizes and Can Be Made Up Special to Meet Your Specific Requirements.

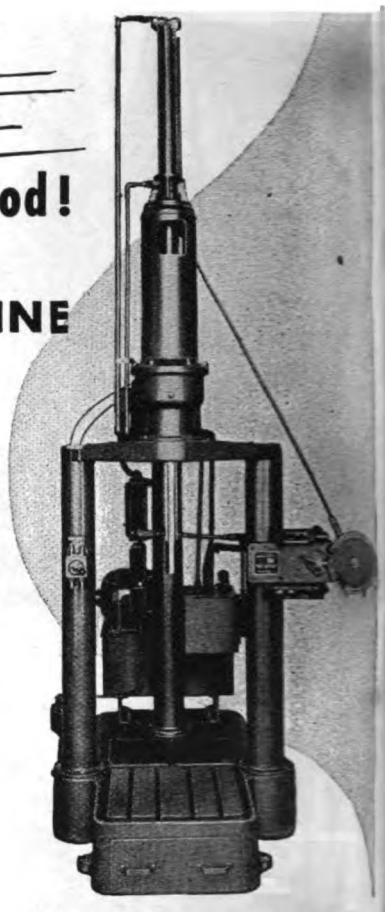
Write for Bulletin MC-106, showing many successful applications of Mines Connectors throughout industry.

MINES EQUIPMENT COMPANY

4275 Clayton Ave. • St. Louis 10, Mo.

Finishes Cylinders FASTER— than by any other method!

FULMER HONING MACHINE



ON cylinder finishing operations the Fulmer Honing Machine *can remove material faster than by any other known method* for a given degree of accuracy and surface finish! Its use assures low maintenance costs in finishing cylinders, and longer operating life between major overhauls.

The Fulmer Honing Machine is capable of honing cylinders of all diameters encountered in railroad operation—Diesel liners, gas engine, air pump, air brake, stoker, reverse gear, piston valve and many other types of cylinders. It can be supplied in various sizes, with working strokes from 25″ to 72″, and with cylinder honing capacities up to 20″ in bore.

The Fulmer Honing Machine is designed for heavy loads, continuous operation, and to deliver maximum torque into the spindle for fast stock removal. It is your best answer for accurate, rapid finishing of all internal cylinders.

Write Today for Detailed Information **C. ALLEN FULMER COMPANY**
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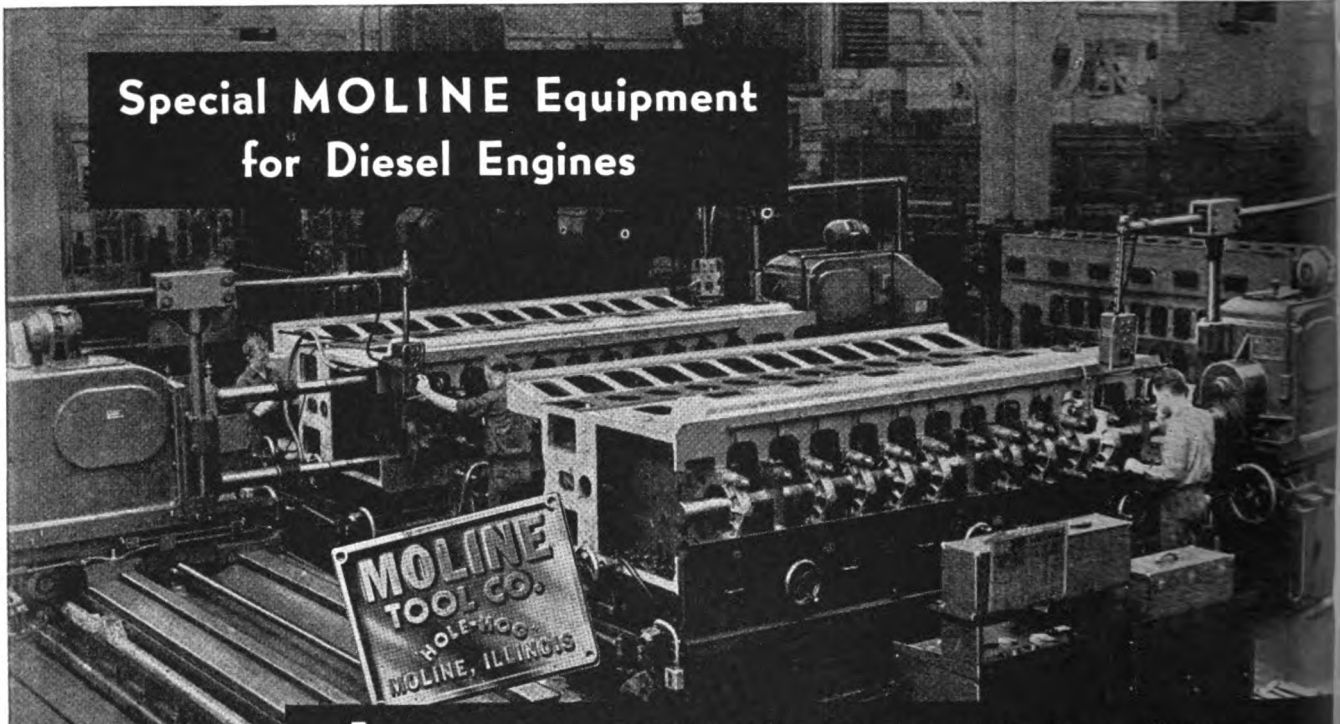
DEALERS: A few attractive territories remain open. Write today.

ROD BORERS • HONING MACHINES • PISTON RING LAPPERS • CENTRIFUGAL CASTING MACHINES

Special MOLINE Equipment for Diesel Engines



THE ABOVE PHOTO, taken in the Beloit, Wisconsin plant of Fairbanks-Morse and Company shows equipment furnished by Moline Tool Co. for the manufacture of Fairbanks-Morse opposed piston type Diesel engines which were used for power in submarines and Navy surface craft. These special Horizontal, Hydraulic Feed Boring Machines, the MR110 and the MR111, are here used together to bore the two crank and two cam lines in a large diesel engine block in one operation. The complete installation weighs approximately 124,000 pounds and covers a floor area of 38 x 22 feet. This type of completely automatic equipment may have many peacetime uses in your plant. Send for catalog sheets and complete details on this special equipment.

MOLINE TOOL CO. Moline, Illinois

OUT OF THE SHOP...

...QUICK!

The extra power of the Wilson E.P. and E.C.T. Series Air Motors permits fast removal of all types of deposits from straight or curved tubes of locomotive boilers. Valuable down time is saved by the non-stalling characteristic of these motors while the exclusive Wilson automatic valving of operating air cuts air consumption to a minimum.

Thomas C. Wilson, Inc. maintains a large research engineering staff to help you solve difficult or unusual tube cleaning problems. Write today and ask for the Wilson Tube Cleaner's Check List and the 40-page bulletin describing the complete Wilson line.

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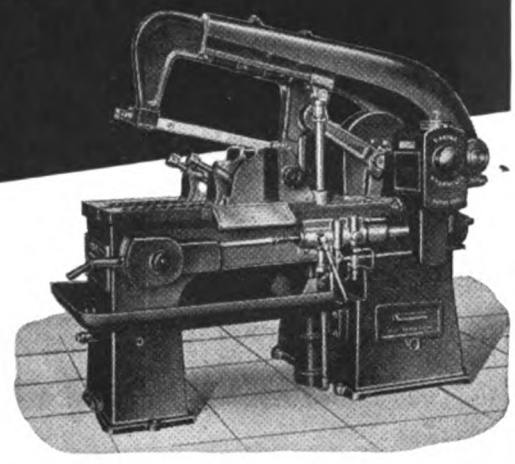
PIPE AND TUBE CLEANERS EXCLUSIVELY

THOMAS C. WILSON Inc.
21-11 44th AVENUE, LONG ISLAND CITY 1, NEW YORK

Pivoted Arm Construction Open Front Design

FOR MAXIMUM CUTTING EFFICIENCY



ALL RACINE Metal Cutting Machines employ "Pivoted Arm Construction and Open Front Design" combined with "Straight Line Pull on the Connecting Rod." Nearly forty years of research and manufacturing experience prove these principles correct.

The sketches below illustrate RACINE's "Straight Line Pull" as opposed to angular pull. The connecting rod is parallel with the blade. Feeding pressure is directly against proper and adequate bearings provided to carry these loads. The blade is aligned with the exact center of the connecting rod. These features eliminate side and angular stresses, insuring a free running blade and the maximum in cutting speed and accuracy.

The following are added RACINE advantages — Progressive Feed throughout the cutting stroke. The open front facilitates loading. Removable front vise jaws. Replaceable table plates and wear plates on vise jaws. Tee slots in table plates to permit clamping of odd shaped work. Single lever hydraulic operation and control. All these contribute to the work capacity of this equipment.

The long experience and engineering skill that developed the efficiency of RACINE Machines can be applied to your metal cutting operations. Write for interesting Catalog No. 12. Include a brief outline of the work you have to do.

RACINE "Variable Volume" PUMPS

A Modern Source of Hydraulic Force

Smooth, oil-cushioned power for your oil hydraulic circuits. Pressures from 50 to 1000 lbs. Capacities 1 to 30 G.P.M. from *just one pump*. Request Catalog P-10-C for RACINE's complete line of Pumps and Valves.

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★ RACINE'S Modern Design, with simple, single lever control, insures easy handling, lower cost per cut.

★ RACINE'S line is complete. Capacities 6"x6" to 20"x20". General purpose and high production type machines.

RACINE TOOL AND MACHINE COMPANY
1740 State St., Racine, Wisconsin, U. S. A.

RACINE

Car Specialties by Motor Wheel

All Standard Type Spring Plates produced for your requirements

Defect Card Holders made of heavy gauge, pressed steel construction.

Weatherproof. Large opening for convenient access.

The Above Equipment Fully Meets A.A.R. Requirements

T-Z RAILWAY EQUIPMENT CO., Inc.

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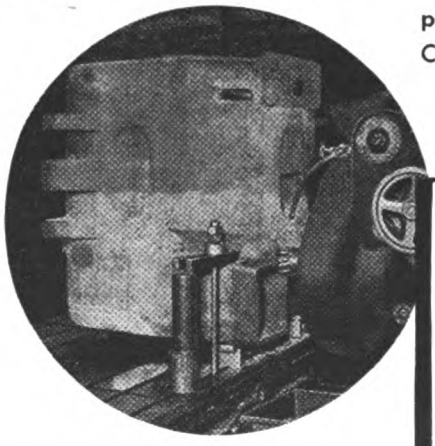
National Railway Sales Representative ***Motor Wheel Corp., Lansing 3, Mich.***

UNIVERSAL BORING MACHINE FEATURES INSURE PRODUCTIVE CAPACITY AND ACCURACY

1. Three Bed Ways — span 44 inches.
2. Table Semi-Box design, heavily ribbed.
3. Motor mounted directly on base.
4. Saddle lead screw nut mounted between guiding ways.
5. Centralized right hand control.
6. Heavy duty type — heaviest 4" spindle machine built.
7. One shot lubrication for head; also for saddle and table assembly.



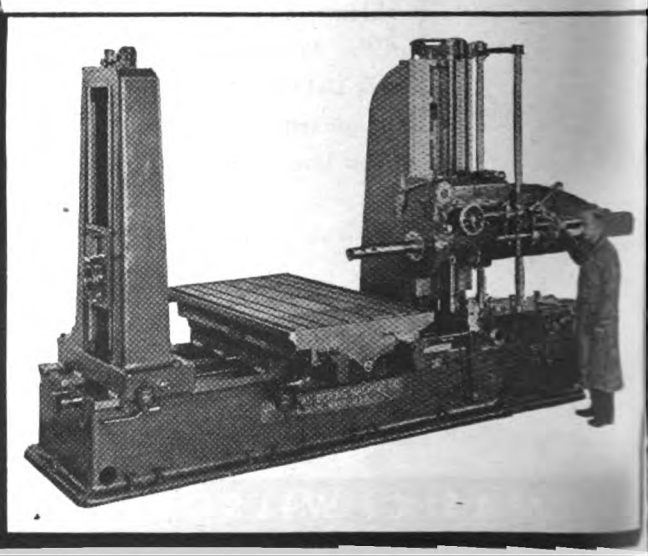
Railway construction and maintenance shops will find the UNIVERSAL BORING MACHINE a welcome addition, because of its versatility in precision machining operations.

This improved UNIVERSAL BORING MACHINE is available in 4" and 5" spindle sizes. Both are readily adaptable to do many boring, milling, turning, facing, recessing, and threading operations.

And UNIVERSAL can also show you how to handle many more precision jobs on a UNIVERSAL HORIZONTAL BORING MACHINE with the Tri-Way bed.

Write today for complete information.

◀ Milling Diesel Engine Frame for Switching Locomotive.



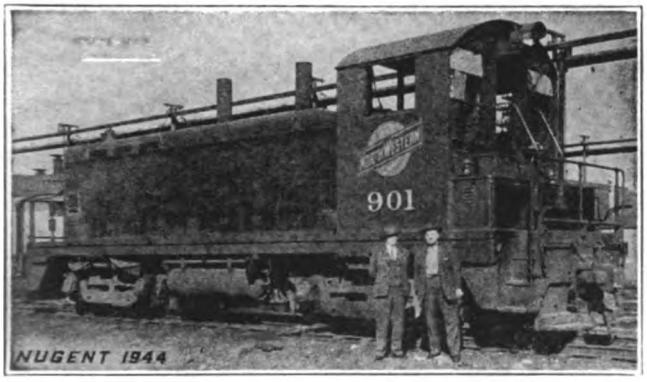
UNIVERSAL

BORING MACHINE COMPANY

HUDSON, MASS., U. S. A.

1576 ENGINE HOURS

. . . on one recharge set



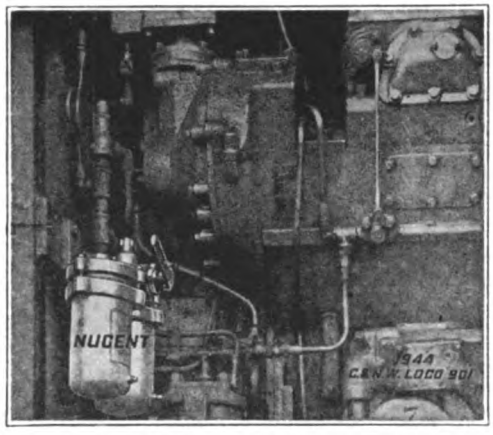
"No. 901"—a 900 h.p., 2 cycle Diesel switcher moving variable loads around curves and up and down ramps—recently operated 1576 engine hours without replacing the absorbent filter recharge in its Nugent Duplex Fuel Oil Filters. During this time 283,680 gallons of fuel oil were filtered and the engine consumed 8,012 gallons. The balance of the oil was by-passed back to the storage tank.

That's the kind of filtering that means maximum Diesel engine efficiency and the ultimate in oil conservation.

Get full details on the complete line of Nugent Fuel and Lube Oil Filters . . . write for Bulletin No. 7A.

WM. W. NUGENT & CO., INC.
EST. 1897
431 N. HERMITAGE AVENUE, CHICAGO 22, ILLINOIS

. . . and perfect filtration. That's the performance record of a NUGENT Duplex Fuel Oil Filter installed on the Diesel switching locomotive shown at left.



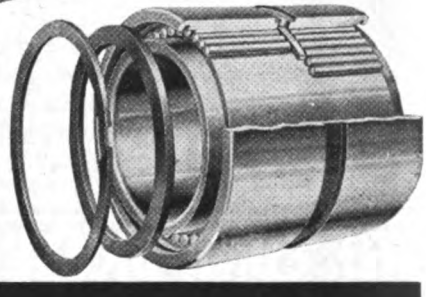
The above view shows the Nugent Duplex Fuel Oil Filters installed in the Diesel locomotive shown at the left. The throw away type filter recharge used in these filters is easily and quickly inserted in the filter cage, assuring the user of constant, thorough filtering.

NUGENT FILTERS

---

5 Points of Superiority in Baker Valve Gears

The new Baker Valve Gear has five points where McGILL *MULTI-ROL* Bearings may be applied. Thus great savings in maintenance plus large increases in mileage are effected. Baker Valve Gears and McGILL *MULTIROL* Bearings make a record-breaking team. 500,000 miles and more without attention is not unusual.



Special Bearings can be made to suit any unusual condition and to answer any specific problem. Write the McGILL Manufacturing Company, Inc., Valparaiso, Indiana for information.

THE PILLIOD COMPANY 30 Church St., New York, N.Y.—310 S. Michigan Ave., Chicago, Ill.
Factory—Swanton, Ohio

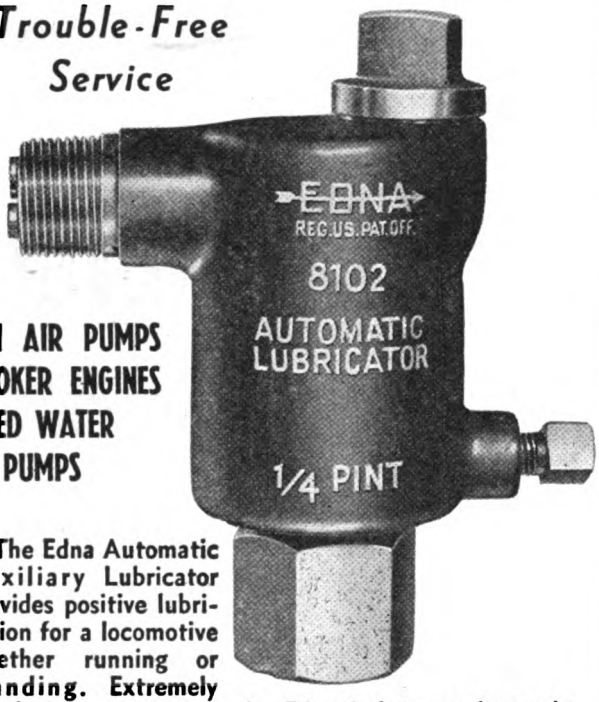
EDNA

(Reg. U. S. Pat. Off.)

UNIVERSAL LUBRICATING SYSTEM

AUTOMATIC AUXILIARY LUBRICATOR

PROVED BY YEARS of Trouble-Free Service



..ON AIR PUMPS
..STOKER ENGINES
..FEED WATER PUMPS

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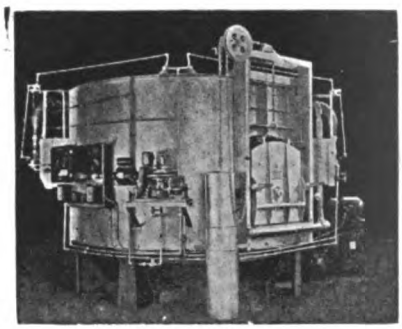

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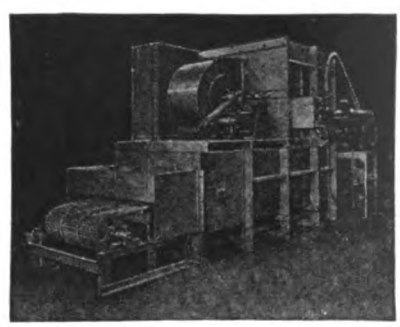

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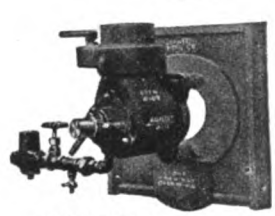

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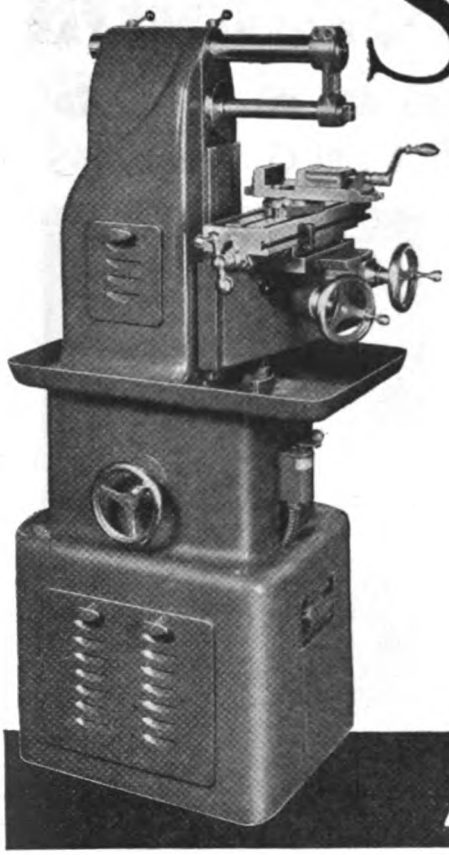

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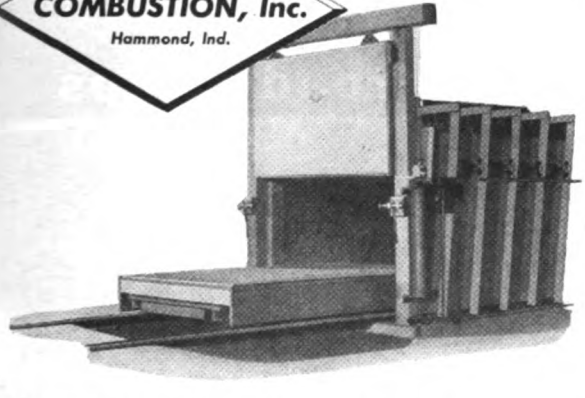

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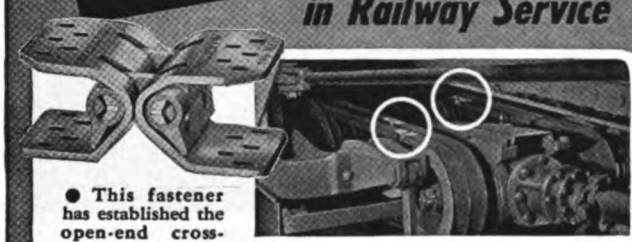

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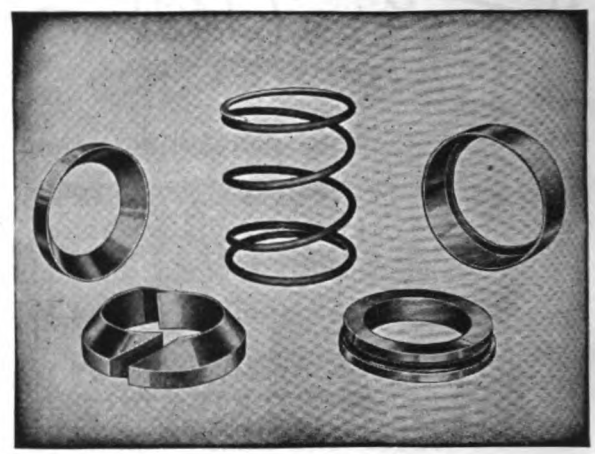

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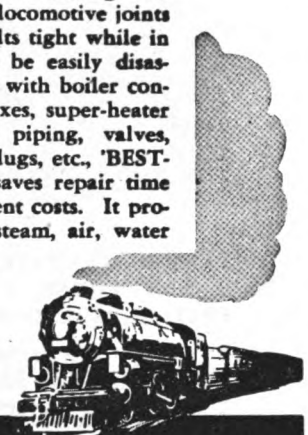

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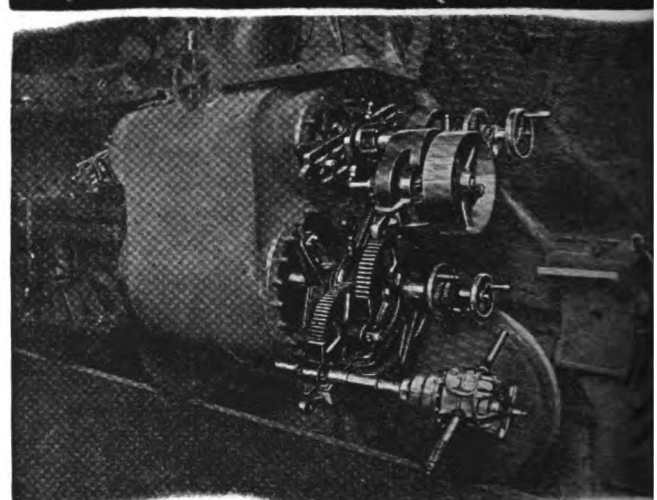

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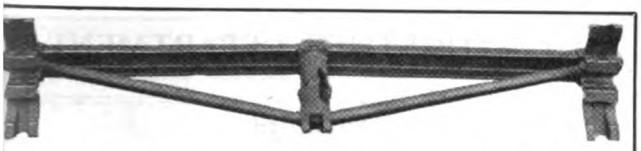

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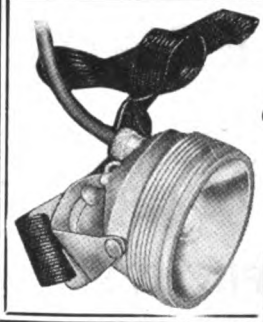

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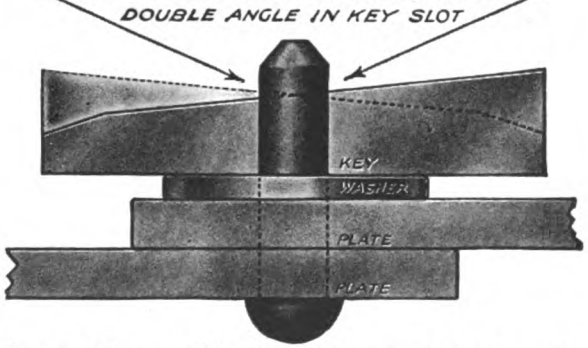

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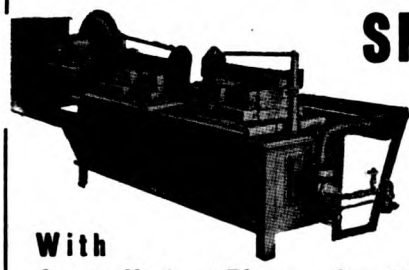

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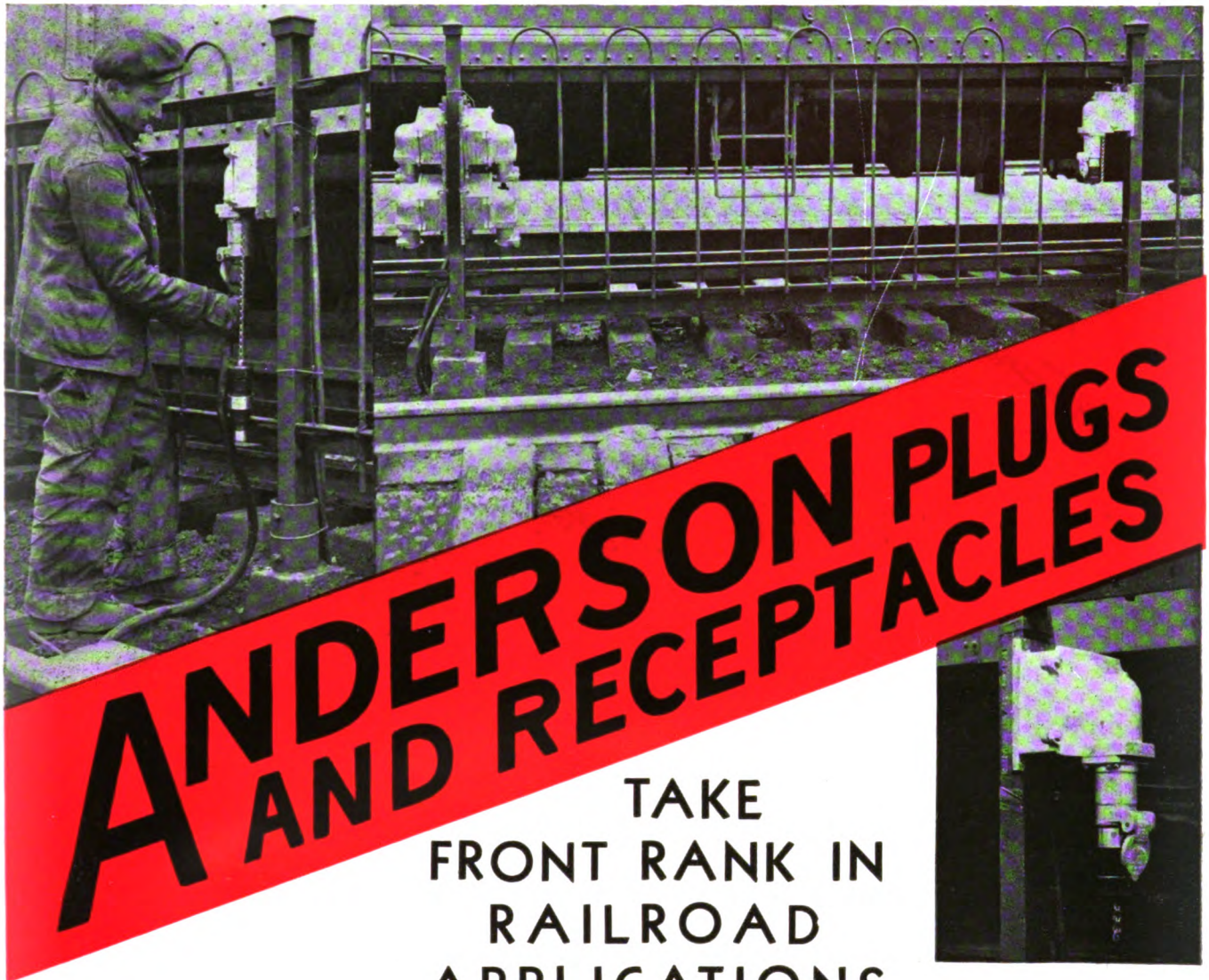

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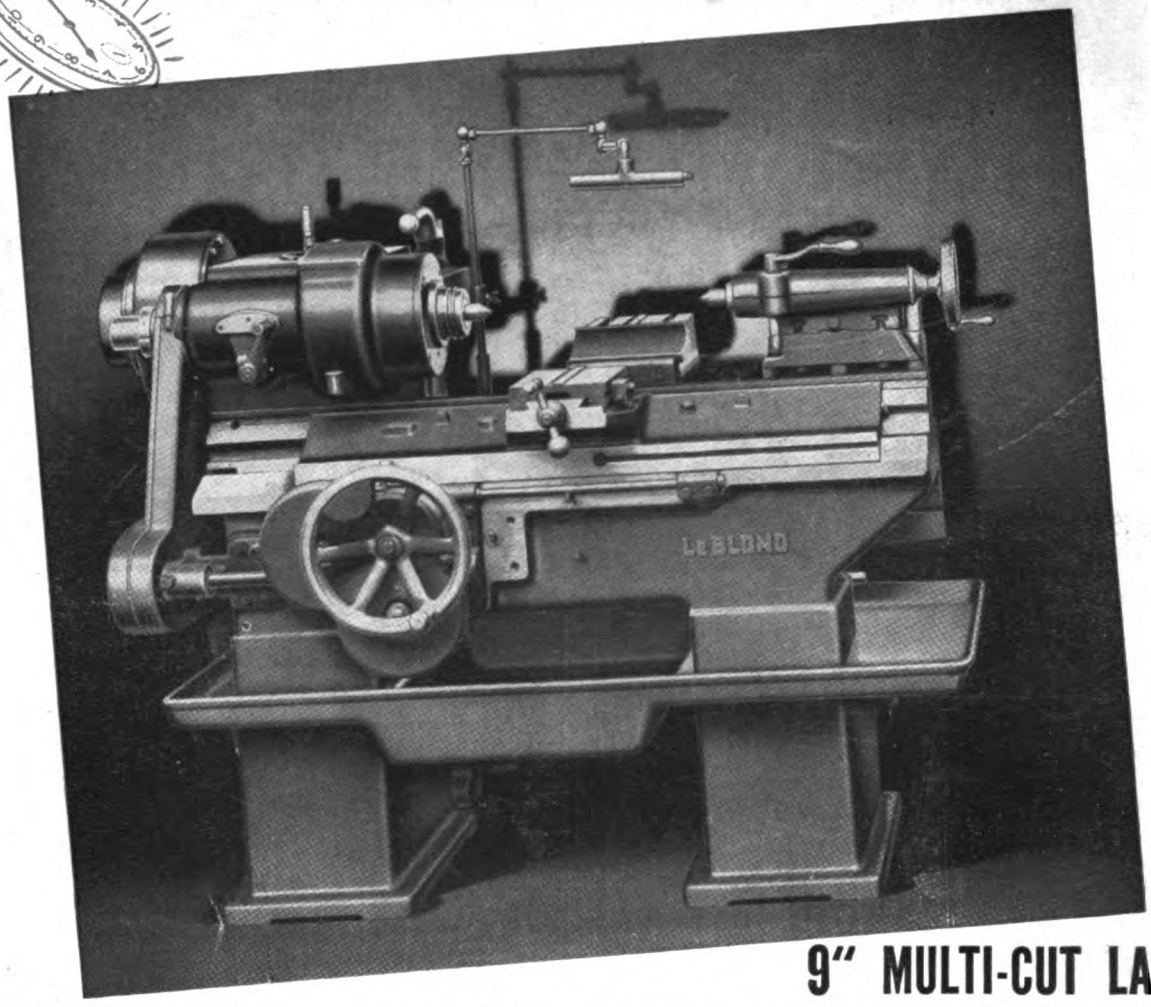

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